SCIENTIFIC AMERICAN

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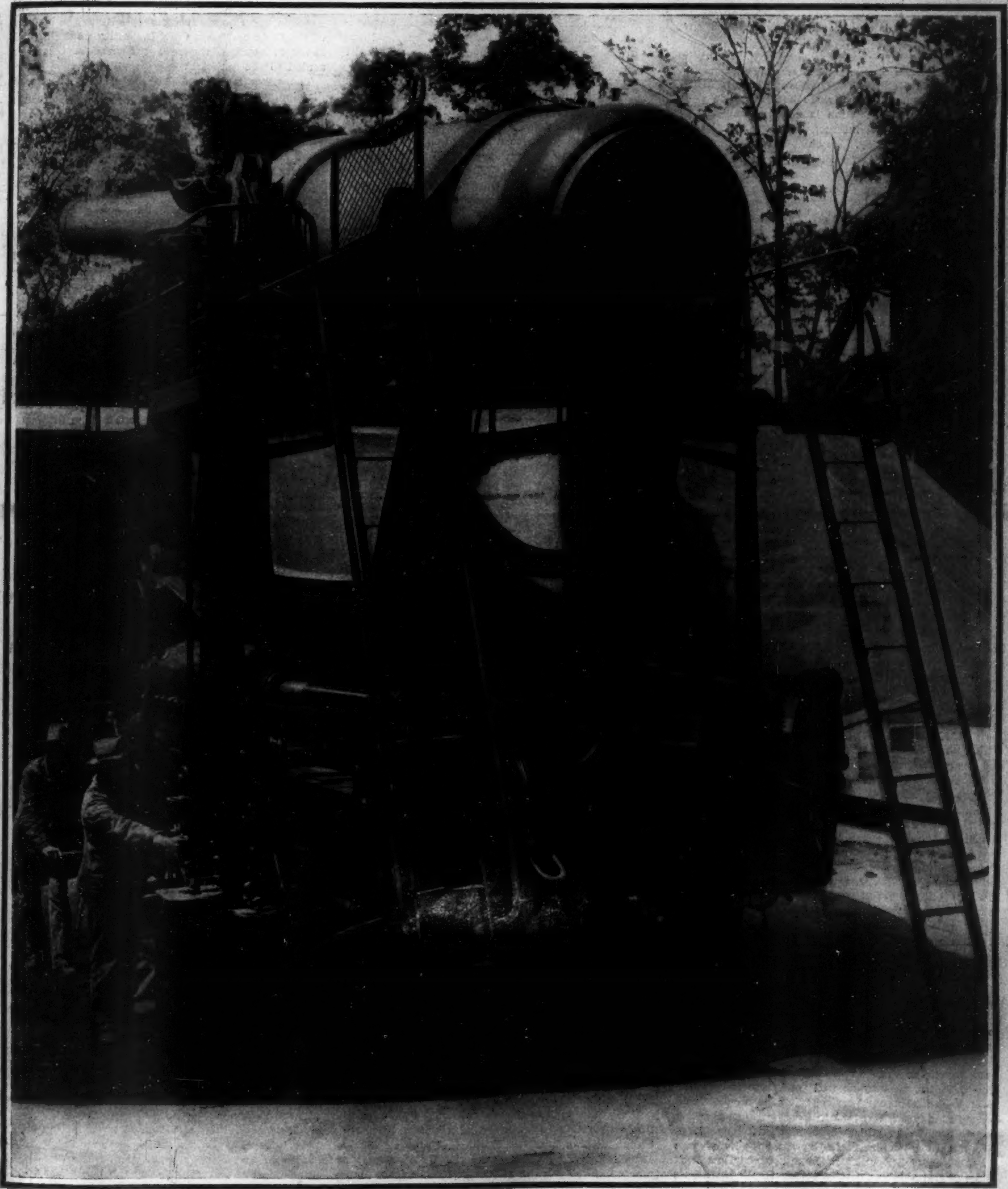

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Twelve-inch 42-calibre Gun on Disappearing Mount. Weight of Gun, 131,500 pounds; **Weight of Shell,** 1,000 pounds; **Muzzle Velocity,** 23,000 feet per second. **Maximum Range,** 18 miles. Gun is traversed and elevated by two 4-horsepower electric motors, whose controllers are seen in lower left-hand corner.

THE WAR DEPARTMENT'S EXHIBIT AT ST. LOUIS FAIR.—[See page 144.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, AUGUST 27, 1904.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE SCIENTIFIC AMERICAN AND THE ST. LOUIS FAIR.

In spite of some rather serious but inevitable defects the St. Louis Exposition is unquestionably the most comprehensive and instructive of any that have been held in this country. Its chief drawback, as we have already stated in these columns, is its huge area size; but this was scarcely avoidable when once the sponsors of the fair had planned it on the vast scale upon which it has been built. The late President McKinley once spoke of expositions as being the timekeepers of progress, and in the intervening eleven years since the last great international fair was held in this country, such has been the feverish activity of industrial life, not merely in America but in every part of the civilized world, so vast have been the strides that have been taken in many of the industrial arts and sciences, that it seems to require an exposition of the magnitude of the present one at St. Louis adequately to record, in concrete form, the world's advancement during these eleven years.

If it be a difficult task merely to walk through the exhibits and see them with one's own eyes, it becomes a still more formidable task to serve as the eyes of the great multitude of readers of the SCIENTIFIC AMERICAN, and adequately set before them by pen and by picture a comprehensive review of the Exposition. Of the two alternative methods of doing this which presented themselves, that of publishing a special World's Fair number devoted exclusively to the Exposition was rejected, for the reason that it was altogether impossible to do justice to the fair in any single compact edition that would not be too cumbersome to serve its purpose. Consequently we have decided to distribute our World's Fair articles through the successive issues of the SCIENTIFIC AMERICAN and the SUPPLEMENT—a policy which will enable us to place the subject more exhaustively before our readers than would be possible in a single issue. Our editor has just returned from a two months' residence on the grounds, and the material that he gathered will be used in the form of illustrated and descriptive articles that will appear in our various publications during the next few months.

RAILWAY SPEEDS HERE AND IN EUROPE.

There are some controversies that will not down, and one of the most persistent of these is that relating to the relative speed of railroad travel here and in Europe. We have been in receipt lately of several letters asking us for an expression of opinion on the subject, and we therefore think it well to state, for the benefit of those who are interested in the question, that in respect of the number and speed of fast express trains, our railway service in this country simply cannot compare with that of France and England. We say this with the full knowledge that there are a few fast expresses that maintain a high average speed for long distances in this country—trains which, if the element of total distance be taken into account, as in the case of the Twentieth Century Limited, on the New York Central and Lake Shore lines, have no competitor in Europe. There is also a service of very fast trains running between Philadelphia and Atlantic City, during the summer months, which are scheduled to run at a higher speed than the fastest of what might be called short-distance expresses in other countries. But when it comes to a broad comparison of fast express service in France and England with that of the United States, we may as well confess to the uncomfortable fact that our service, taken as a whole and judged merely with regard to its speed, can scarcely be entitled to be called first-class. After we have eliminated the Empire State Express, with its average speed of about 54.5 miles an hour between New York and Buffalo; the Twentieth Century Limited, with its average speed of about 50 miles an hour from New York to Chicago, and the service of a few fast trains from Philadelphia to Atlantic City, maintained during the summer months, we have mentioned all of the trains that can be presented in comparison with the remarkable service that is being run on regular schedule this year on the other side of the Atlantic.

It was only a few years ago that the French railroads took the lead from England by putting into service several trains that ran at average speeds of from 55 to 60 miles an hour. At the present time there are in France thirty-five trains that are booked to run at speeds from start to stop of 55 miles an hour and upward. The fastest of these runs from Paris to Longeau, 79 miles, at 60.8 miles an hour; another is timed to do the distance from Paris to Busigny, 112½ miles, at 60.3 miles an hour; the next fastest run is the 109 miles from Paris to Abbeville, at 60.2 miles an hour, and the fourth fastest train runs from Paris to St. Quentin, 95¼ miles, at 60.1 miles per hour. Then follow seven trains, with a timed speed of from 58 to 58.6 miles per hour; eleven trains at from 57.1 to 57.8 miles per hour; and ten that run at an average speed of from 55.0 to 56.5 miles an hour. These runs are made without a stop over distances that will average about 85 miles.

During the past two years the English railroads have been building more powerful engines, and the result is seen in a greatly-accelerated train schedule. They have regained the lead in fast express service by putting in regular service a total of fifty-three daily trains scheduled to make a speed of 55 miles an hour and over from start to stop. The fastest run of these is over the 44¼ miles from Darlington to York at 61.7 miles an hour; but the most meritorious are the runs from London to Bath, 106¼ miles, at 59.4 miles; from London to Bristol, 118½ miles, at 59.2 miles; two trains between London and Exeter, 193¾ miles, at 56.7 miles, and three at 55.3 miles an hour. These last-named trains are run on the Great Western Railway, on which a train carrying the American mails was recently run from Plymouth dock to London, a distance of 246¾ miles, at an average speed of 65.49 miles for the whole journey, the last 36 miles being covered at the rate of 79.17 miles an hour. The fifty-three daily expresses that run in the British Isles include twenty-four trains with a schedule speed of 55.1 to 55.8 miles an hour; thirteen trains with a speed of from 56.2 to 56.9 miles an hour; seven trains of from 57.0 to 57.8 miles an hour speed; five trains of from 58.1 to 58.9 miles an hour speed; three of from 59.1 to 59.4 miles, and one of 61.7 miles per hour schedule speed. The average distance of these runs, start to stop, is 101 miles.

It must be understood that this comparison is made merely on the basis of the actual number of high-speed trains available to the traveling public. No account is taken of train weights. Compared with American train weights these European trains are light; but so are the engines. Moreover, though the trains are lighter, their carrying capacity, owing to the lighter construction, is equal to that of our larger and heavier trains, so that the passenger is still the gainer. It would not pay to run so many trains at such high speeds in the United States, for the reason that our latest Pullmans weigh over 60 tons, or over 2 tons to the passenger, which, from an engineering point of view, is an absurd proportion. The only argument in their favor is that such heavy cars are safer in a collision; but would it not be a saner policy to build our cars lighter, abolish collisions, and operate our railroads with the same care that enabled the English roads, in spite of their many fast trains, to operate their railroads, as they did the year before last, without killing a single passenger?

Surely this is a problem worth consideration.

A GREAT RAILWAY SCHEME.

The government of Canada has entered into partnership with a newly-incorporated company for the construction of a transcontinental railway from the Atlantic to the Pacific, to be wholly within Canadian territory. This road will be about 3,600 miles in length; and the total cost is estimated at $150,000,000. This does not include the branch lines, aggregating about 2,000 miles.

The western division, extending from Winnipeg to the Pacific, is to be constructed by the Grand Trunk Pacific Railway Company, a chartered corporation, not yet organized, to be controlled by the Grand Trunk Company, which will be the majority stockholder. The line from Winnipeg to the Atlantic terminal, at or near Moncton in the province of New Brunswick, will be built by the government, and leased to the Grand Trunk Pacific Company at a 3 per cent rental for fifty years.

From Winnipeg to Edmonton, about 800 miles, the line will run through a prairie country, paralleling or intersecting branches of the Canadian Pacific and Canadian Northern railways. Northwest from Edmonton, for 300 miles to the foothills of the Rocky Mountains, there are no engineering difficulties until the route enters the valley of the Upper Peace River. Following this valley through the Rockies, the surveyed line reaches a point where a southerly turn brings it to the canyon of the Skeena. By a tortuous and difficult route through the Coast Range, the line finds its western terminal at or near Port Simpson, within a dozen miles of the recently defined southernmost point of the Alaskan boundary. An official statement presented to the Senate gives the length by the surveyed route, through the mountains, as 766 miles. This makes 1,886 miles for the total length of the division, Winnipeg to the Pacific, to be built by the company.

The surveys of the eastern division have not yet made sufficient progress to permit a definite location of the route. The most favorable line will probably be found north of the height of land, crossing a succession of valleys which have their outlet in Hudson's Bay. The St. Lawrence River will be traversed by the great bridge now under construction a few miles west of Quebec city. Between Quebec and Moncton, the line will come very near to the boundary of the State of Maine, until the valley of the St. John River is reached, thence a choice of routes is presented to the seaboard.

The government provides the cost of the eastern division. For the western division, bonds issuable by the Grand Trunk Pacific Company are to bear government guaranty of 3 per cent in respect of three-fourths of the total amount; the interest on the remaining fourth part is to be guaranteed by the Grand Trunk Company. The government guaranty, however, becomes operative only on the completion of the railway from Winnipeg to the Coast. Interest upon outlay in construction is to be capitalized. The western division must be completed by December 1, 1911.

THE ROMANCE OF LIGHT.

There are few objects in daily use about which we stop to ask how they came to us, and through what stages of development they passed before arriving at that perfection which we now enjoy. Should we turn a retrospective eye toward "those good old times," we should be amazed at the slow steps of progress, and the almost infinite struggles through which inventions came into acceptance.

The connection between a burning fagot and an electrolier may seem remote, but every link in the chain is perfect. From the smoky rays of the first flaring brand of the cave-dweller, to the electric light, filling the most spacious halls with its glory and making the streets of our cities luminous as the day, the way has been paved with human effort and illumined by human genius.

The pine torch was no doubt coeval with fire in the hands of men. The resinous knot was the first step in artificial illumination. Its use is found in every savage tribe and nation, while it is a necessity in the lives of all first settlers in new countries. When the nineteenth century dawned, the children of America were learning to read by the light of pine knots and the crackling of logs of an open fire-place; so closely are we related to what may seem the remote past.

It is hard to believe that the world groped on to the thirteenth century without discovering even the tallow candle; yet so it is. The expression that "mankind was plunged in darkness during the early ages" is true in every sense. It was perhaps the accidental burning of a bit of fat of some slain animal that suggested its use as a luminant, while the hollow shell from the sea, a concave rock, or a mold of sun-baked clay held the fat, which was burned by placing a rush in the fat, with the lighted end projecting over the edge of the rude dish. Step by step the lamp was fashioned into a thing of beauty, though barely a joy forever. Thus came the first improvement in the art of domestic illumination.

Admirable specimens of lamps in terra cotta, in stone, in brass, and in bronze have been found on sites of Hebrew cities and in the temples of Hindustan. From the tombs of Egypt; from the tumuli of Assyria and ancient lettered Babylon; from the opened graves of Chaldean sages, come examples of household lamps, revealing a general use many centuries before the Christian era. Herodotus speaks of a procession of lamps, as a scene of imposing magnificence, and Homer sings of a torch borne upon a staff, its flame no doubt feeding upon the wax from the wild honey, and the resinous gums of the forest trees, nearly a thousand years before the Christ.

So, from the fat of slain animals, the resinous products of the forest trees, and the wax of the wild bee came those lights which gleamed upon fair women and brave men at Belshazzar's feasts, the revels of Dives and the grand balls given by the first Napoleon in the Palace of the Tuilleries.

When men discovered the art of extracting oil from the olive and other vegetable sources the use of the lamp became very general among the wealthy and noble. Only they could enjoy the less offensive methods. Lamps wrought in cunning form of marble, silver, and gold were ornamented with precious stones, inlaid with curious handicraft and artistic workmanship indicate a high position for this method of illumination. Even the terra-cotta specimens, used in

cottages, are graceful in shape with an elegance of finish which no art of modern times can surpass.

Beautiful as indeed they were, of how little practical use! An eighteen-penny lantern of the eighteenth century, with its tin reflector and its bullseye of third-rate glass, diffused a better light than any lamp of Rome or Greece in the days of their greatest glory.

As they knew no method for refining oil, they made it a luxury by mixing with it the perfumes of the rose and of sandal wood. Although detracting from its burning properties, the fragrance was supposed to compensate for diminished light. The flame emitted an enormous amount of smoke, and fluttering in the slightest breeze spluttered out altogether in a gust of wind. At the end of an evening conference a party of noble Romans would resemble a congregation of chimney sweeps.

From Rome the oil lamp passed successively into Germany, Gaul, and Britain. In these countries, torches, rushes dipped in grease and a very odorous fish oil were the methods of artificial lighting until the Roman conquest. The rush-light of that day consisted in a notched wooden stick set in a wooden base. Stalks of the rush were peeled to the pith save for one strand of husk, and passed through hot grease. Sometimes three or more were twisted together and when cold were placed in a notch of the standard, to be pushed up when the fire neared the wood. It emitted a strong flame and a similar odor. You may make one of these, and enjoy for an hour the ancient light of Britain and that which to this day dispels the gloom of night in remote Irish cabins. The candle of the common people was the rush-light of our ancestors. It burned where candles made from wax were too dear and before Chevreul and others found a way to refine a cheap candle grease from the fat of animals.

The Picts and Scots, the Danes and the tribes of Scandinavia had not advanced to the use of the rush-light at the time of the conquest. When torches were necessary they stuck a bit of wood into the body of some fat bird, and supporting the stench as best they could allowed this dismal sort of a candle to burn until the bird became a cinder.

The lamp as brought from Rome continued in use without being greatly modified until well into the thirteenth century, when the invention of candles made an artificial light of comfort to those who could afford it.

The curfew bell which tolled at eight o'clock was no hardship to our ancestors, considering the badness of the lamps which lighted their houses or hovels as the case might be. Through all the mediæval ages, men were supposed to rise at daylight and retire soon after the sun had set.

The first step toward the use of the modern candle was the invention of a tallow torch which came into use about the last of the twelfth century. This remained in use for about a hundred years when the tallow candle either dipped or molded made its appearance, much as it now exists. The haughty barons who forced King John to sign the Magna Charta at Runnymede would have considered a bundle of tallow dips of almost as great value as the rights which they wrung from the unwilling hand of their sovereign. To have stolen one from the kitchen table would have incurred the noose without hope of pardon. Not until the fifteenth century were the burgesses and trades people able to purchase a tallow candle. At the opening of the nineteenth century they were sold singly for about twelve cents each.

Flax being the wick, they burned rapidly. Cotton was more expensive than silk and to use it for wicks was extravagant folly. Three pounds sterling was the price of a pair of cotton stockings one hundred years ago. Tapers made of wax had been in use in churches since the ninth century, but no one ever dreamed of using so expensive and sacred an article for domestic purposes. Toward the close of the fourteenth century they were timidly introduced in a few palaces, and the homes of great noblemen. To offer a wax taper at a shrine was a princely gift, and absolution followed the presentation of a taper weighing one pound. To vow a taper to the Virgin Mary was like vowing a hundred doves to Venus or a heifer to Juno. At a cost of four hundred crowns in gold, King Henry sent two wax tapers weighing twenty pounds each to Thomas à Becket, hoping thereby to appease the great primate of Canterbury.

In the Cathedral of Pisa a ton of bronze slowly swings from the lofty dome. A keen-eyed student watches its regular oscillations as its hundred wax tapers flash upon a thousand worshippers engaged in evening prayer. The great candelabrum, almost a world's wonder at the time, was weaving a message of light in Galileo's brain, and from the cathedral he went away to startle the world with the story of its motion and to reveal the secrets of the pendulum as a means for measuring time. Still swings the chandelier under the cathedral's dome, with the same potent motion as when its flashing lights taught the old astronomer the deeper story of the world's life.

In the year of 1509 a few enterprising chandlers conceived the idea of mixing animal fat with the wax, but the deceit being discovered the king by royal edict debarred every chandler of the realm from making and offering for sale any mixed substance or composite article in the place of wax.

It was no doubt after seeing on his grocery bill that he was paying 36 shillings a dozen for candles that Oliver Cromwell in the year 1654 blew out one of the two candles on his wife's work-table, on the ground of unnecessary extravagance. Louis XV. complained that he could keep a regiment, music and all, with what was spent in lighting the palace at Versailles. It is related of Voltaire, that, when dissatisfied with the salary afforded by Frederick the Great, he used to put in his pocket the wax candle ends of his royal master, and from them turned quite a pretty penny. The cost of lighting the Tuilleries under the first Napoleon with wax candles was about what it would be were the electric lamps of the present day employed—namely, $4,000 per annum. When the Emperor was giving magnificent fêtes at Dresden he often spent six hundred dollars for the wax candles of a single night's carousal.

When, however, wax and tallow had been sufficiently cheapened to allow their use in drawing rooms and boudoirs, the oil lamp and the rush light were relegated to the parlors and kitchens. No room in which costly paintings and gilded furnishings began to exhibit elegance and refinement could tolerate the smoky and greasy contrivances which remained without improvement through the centuries.

Toward the middle of the eighteenth century the number of lamps increased among the poorer classes, owing to the invention of Colza oil. The new liquid was far cheaper than the olive oil used in France and Italy or the whale oil of England and America. Not till then began the processes of lamp regeneration. It was in 1783 that an enthusiastic and radical reformer, one Argand, discovered a lamp which consumed its own smoke and most of the odor. By admitting oxygen to both sides of a flat flame he increased the light so that a shade became necessary. The new lamp was at once popular in France and England. When improved by a convex reflector placed behind the flame, the light was rendered too dazzling for an ordinary room.

Fred and Phillipe Girard improved this lamp, placed the reservoir for oil below the wick; softened the glare by the use of whitened glass, giving the first effect of beauty to artificial light. It is an interesting fact that the first appearance of the new lamp devised by the brothers Girard took place in London at a party given by the Duchess du Barry, then in exile. Josephine, hearing that it was enthusiastically admired, and jealous that it was not first seen at her soirees, ordered the brothers to bring a lamp at once to the palace. The significance of this circumstance is little beyond the fact that the lamp presented by the brothers to the Empress was decorated by a young and obscure artist, struggling for bread, to be later known throughout the world as Jean Auguste Ingres.

On the arrival of the Pilgrims at Plymouth in 1621 they adopted the Indian's method for light and used the pine knots, furnished in abundance by the virgin forests. No doubt the pitchy drippings of these knots were a source of discomfort to the cleanly housewife, and the candle when it came was greatly prized. Cattle were not introduced into the colony until about eleven years after the arrival of the "Mayflower," up to which time candles were unknown except when imported at rare intervals. Elliot translated the Bible by a spluttering, smoky torch. New England literature was spattered by the dripping flame and clouded, perhaps, by the odorous smoke.

There is a long step between the torch of the fathers, still in use at the opening of the nineteenth century, and the electric searchlight, of which it was the humble progenitor.

The forerunner of the street light was the basket torch, fastened to a building at a street corner, or later swung by a chain across the street. This basket filled with pitch pine knots made the place quite light. Such a basket, but of enormous proportions, was swung from a crane at the top of a high place in Boston and gave the name to Beacon Hill.

In the year 1660 candle making became quite common with the pilgrim housewife. Tallow was not plenty, so the fat of the bear and deer was added to the tallow, increasing the light but softening the candle, making is less durable. The method usually employed was dipping, with a few molded candles for "company." To dip, a number of wicks were placed upon the sticks a sufficient distance apart, the wick suspended vertically. These wicks were dipped or carefully lowered into a pot of hot tallow on a cold day. Tallow would adhere and quickly cool. This repeated until the proper size was reached secured the "taller dip" of the "mothers."

Not alone was the oil from the sperm whale used as an illuminant, but the fatty substance which gives the name to the fish was discovered to be most excellent for candles, being more costly, but of greater power. Inclosed in little square lanterns "spermaceti" candles lighted the streets of Boston, were suspended over the front doors of the wealthy, and adorned the front halls of elegant mansions. That which gave happiness to the young eyes of "Dorothy Q.," the grandmother of the genial "Autocrat of the Breakfast Table," is still in existence.

Not until about 1830 did our fathers have a match to carry in their pocket. Up to that time they must light their pipe with an ember or by the tinder box. Should the fire of the hearth go out he must revive it by steel and flint or make a hurried trip to the neighbor's to secure his fire. At an early hour on a cold morning this was no pastime.

In the early days of the last century, Sir Walter Scott, writing from London, to a friend in Edinburgh, said: "There is a fool here who is trying to light the city with smoke."

Sir Walter's "smoke" was not a human invention. It was a product of nature's laboratory. Accumulations of gas from coal beds found their way to the surface, and being highly inflammable attracted the attention of men who erected altars over them, and their perpetual fires were dedicated to the gods. After the defeat of the Persian armies at Platea, two victorious generals, Pausanius and Aristides, were directed by the Oracle to build an altar to Jupiter, and to offer no sacrifice thereon until they had extinguished every altar fire in the country, polluted by the Persians, and had relighted them with the sacred fire from Delphi. It would be natural to expect men of science to imitate a process of nature which held such promise. For thousands of years the Chinese have speculated upon the meaning of the natural gas which has escaped abundantly from the earth in several provinces.

In 1726 Dr. Hales informed chemists that by distilling a few grains of coal, he had obtained an equal number of cubic inches of "inflammable air," and that, if attempted on a large scale millions upon millions of cubic feet of that valuable substance could be made, and conveyed unseen along the highways of the land, and become the means for obtaining perpetual day. In 1813 Sir Walter's "smoke" was burned on Westminster Bridge in London, and one year later the streets of St. Margarets, Westminster, enjoyed illumination from gas, it being the first parish contracting for such a luxury.

The common kerosene lamp, with its chimney of glass, its varied forms of beauty, its shades modified to every grade of vision and of taste, suggests the relation of man to light. The oil, natural, cheap, brilliant and volatile, was long known to civilized humanity as a crude outflow from the earth. It was not until about 1845 that the iridescent scum seen floating on the surface of a stream near Pittsburg suggested to thoughtful men to dig for a greater supply. Indians came from a distance and soaked it from the water with their blankets which they wrung out into vessels in order to secure a quantity for some secret purpose. When the American found it he was rich beyond computation, at the same time providing at a small cost the best fuel and the cheapest light for the common people. It was not until 1860 that it passed into common use. Since that time it has driven every form of wax, grease, fluid, camphene, and whale-oil lamps from the common use of mankind.

From the clouds overhead, lowering along the horizon as the sun goes down, Franklin and Edison have drawn the electric fire and in our chambers darkness is unknown. All the way from the pine knot to a nightless day has been won from the darkness in the lifetime of one man and he but just reaching the century point.

This is the Age of Light. FRED. HOVEY ALLEN.

On the Lake Erie & Western Railroad, which belongs to the Vanderbilt group, an experiment is to be tried in electrification. It has been determined, according to report, to install electric motors upon portions of the Peoria division where the competition of electric surface lines is keenest, with a view of trying to recover some of the passenger traffic which the road has lost. If the experiment on this division proves successful, it is likely that before another year is ended the Lake Erie & Western will have an electric passenger service all the way between Lafayette and Indianapolis, and will later extend such service to cover every mile of road which comes in competition with surface lines.

The transporter bridge that is being erected across the river Mersey between Widnes and Runcorn, and which was described in a recent number of the SCIENTIFIC AMERICAN, is rapidly approaching completion. The most difficult part of the undertaking has now been successfully accomplished. This was the suspension of the two aerial cables, of a span of 1,000 feet, which are to carry the suspended traveling deck.

GLASS MODELS OF MICROSCOPIC FORMS OF LIFE—AN INTERESTING ART.

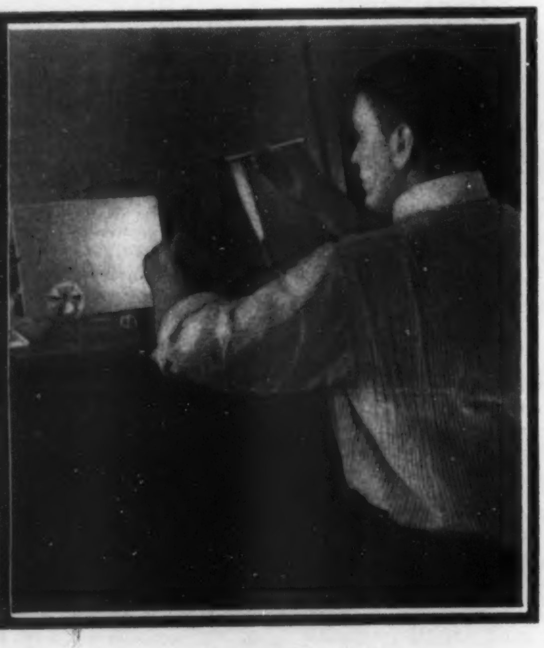
To the layman anything connected with the countless minute protoplasmic forms of animal life that exist in the sea and the waters of the land is a mystery. As the scientist becomes acquainted with them and informed concerning them by means of close study and microscopic research of a most exacting and painstaking kind, it seems an undertaking of considerable difficulty to place before the general public, in our museums, an accurate and at the same time comprehensible representation of these vastly interesting specimens of animal life. To show these animalculæ by means of drawings or even colored illustrations is at best unsatisfactory to the unscientific eye. To give a correct representation of these curious living forms, models are necessary which portray the intricate and sometimes even marvelously involved form of the animalcule. Such models must be made of some material capable of being worked with ease into any desired shape, a material that may be colored any desired tint and that will give a correct idea of the qualities and substance of the original. Many of these animalculæ are transparent or translucent. Especially is this true of marine forms. Hence the material of which the models are to be made must possess these properties. Of course the best available substance is glass. However, the skill and training necessary in the making of these glass models are so great that up to a short time ago it had not been accomplished in this country, though it has been done successfully in Europe, the few models of this kind to be found here having been made by Blascha in Germany.

Hydroid Polyps.

Hydroid Polyps.

Hydroid, Natural Size.

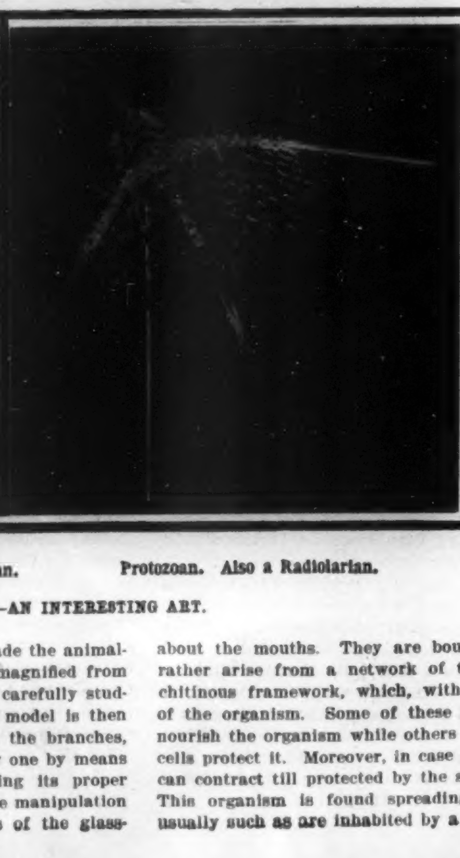
Studying a Specimen Through the Microscope.



Fashioning a Glass Model.

Bryozoan, Bicellaria Bella.

Protozoan. Siliceous Skeleton of a Radiolarian.



Protozoan. Also a Radiolarian.

GLASS MODELS OF MICROSCOPIC FORMS OF LIFE—AN INTERESTING ART.

At the present time a considerable number of these beautiful representations of protoplasmic life are to be seen at the Museum of Natural History in New York, where they have been made by Mr. Mueller, a glass worker, under the direction of Dr. Dahlgren, of the Department of Preparation. Aside from the impossibility of distinguishing or even seeing many of these organisms with the naked eye, the glass models exhibit the form, structure, and color far better than the actual preserved specimen; for preserved specimens usually lose their natural shape and color in spite of and often through the action of the preserving medium.

When one of these models is to be made the animalcule is first microscopically examined, magnified from 10 to 700 or 800 diameters, and is then carefully studied, sketched or modeled in clay. The model is then painstakingly built up, piece by piece, the branches, tendrils or filaments being added one by one by means of the blowpipe, each member receiving its proper shape and formation by the most delicate manipulation of the blowpipe and other instruments of the glass-worker's art. The extreme delicacy and nicety of this work, the accuracy and patience necessary, need no comment. A glance at the accompanying photographs of the completed models is sufficient.

Many of the models on exhibition at the Museum of Natural History are of the class of Protozoa, too small to be seen with the naked eye, composed of a single cell, and such as are popularly known "to be found in a drop of water." One of our photographs shows a model of the siliceous skeleton of one of these, a radiolarian found at the depth of perhaps thousands of fathoms and entirely invisible to the naked eye. Although from a biological standpoint a simple structure, it is very complicated and marvelously wrought. This skeleton is invested in a protoplasmic capsule which forms the living portion of the organism.

Another photograph shows a model of a Bryozoan (*Bicellaria bella*), also an inhabitant of the deep sea. It is very minute but much more highly organized than the preceding type. While the individual organism is almost indistinguishable to the naked eye, it often forms colonies as large as a watermelon. One particular species of Bryozoa occurs in the immediate vicinity of New York, and Mr. Mueller is at present at work on a model of a specimen of this kind.

A third illustration shows a group of hydroid polyps magnified about twenty diameters, presenting a beautiful flower-like appearance with long contractile stems and waving tentacles attached in a circle about the mouths. They are bound together by, or rather arise from a network of tubes invested in a chitinous framework, which, with the tubes, is part of the organism. Some of these polyps are used to nourish the organism while others containing stinging cells protect it. Moreover, in case of danger the stems can contract till protected by the spines at their base. This organism is found spreading over dead shells usually such as are inhabited by a hermit crab and to

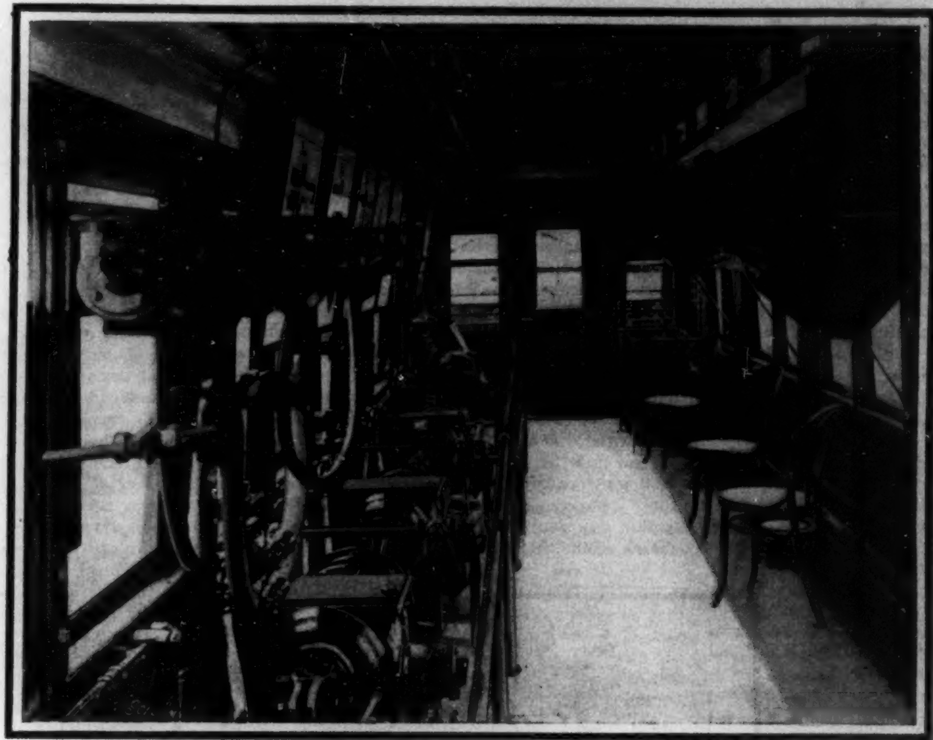
the unaided eye presents simply the appearance of a fine, almost colorless fuzz.

A fourth photograph represents a model, natural size, of another hydroid. The original of this model is a deep purple in color and exhibits in a striking way the peculiar flower-like beauty so characteristic of organisms belonging to this class. The last two photographs are of models of organisms similar to one or the other of those described above and the similarity is easily seen.

For courtesies extended in furnishing the information contained in the foregoing account, we are indebted to Dr. Dahlgren, of the American Museum of Natural History.

THE NEW YORK SUBWAY INSTRUCTION CAR.

That the man in charge of a train to run in New York's Subway may be entirely competent to fulfill his responsible position, the Interborough Rapid Transit Company is using an instruction car, where the prospective motorman may be taught something of the construction and operation of the apparatus he is to handle. In this instruction car, the applicant is shown the use and mode of operation of every piece of mechanism that will come under his charge, is taught how to handle it and what to do in almost every emergency that can arise.



INTERIOR OF THE CAR USED FOR THE INSTRUCTION OF NEW YORK SUBWAY MOTORMEN.

The school car is similar to the regular service cars to be run in the Subway, with the Sprague-General Electric multiple unit system of control. The apparatus is uncovered for demonstration purposes wherever possible—master and air-brake controllers, contacters, reverser, pump governor, switch-board, and the like. Portions of the apparatus underneath the car have, where possible, been placed inside of it to facilitate the explanation of their operation. In the case of the motors, motor resistance, and air pumps this, of course, was thought to be neither feasible nor necessary.

In addition to the regular equipment the car contains a complete air-brake outfit for a six-car train, operated from the brake controller which is used to make the men familiar in all details with this complicated mechanism. It contains, moreover, a defective triple valve, the presence of which the men must detect after a certain amount of teaching. To facilitate the instruction there are additional parts, such as the auxiliary reservoir and the brake cylinder, with portions of the metal cut away to permit the instructor to explain their operation fully. A triple valve similarly cut away, and connected in tandem with another operating triple valve, fully demonstrates the working of this complicated piece of mechanism. To supplement all this a series of colored drawings show the details and operating positions of every important piece of apparatus. A section of contact rail with the rail shoe is used to teach the men what to do in case of trouble there. An automatic car coupler and drawbar is installed for a similar purpose. A complete set of controller and air-brake couplings is employed to demonstrate their use in operation or emergency.

The safeguards in the system used are manifold, and so complete that only a rather inventive mind can conceive any situation which the prospective motorman has not been taught to meet. Should the motorman release the controller handle while it is in a running position, not only would the current be immediately shut off but the emergency brakes would at once be set and the train brought to a stop. Should he attempt to reverse his motors while running, the same thing would happen. The controller is automatically governed and no matter how fast the handle is turned, the motors are started at a certain fixed speed. Should the contacters adhere or fuse, the current is automatically shut off. Should the motorman not see or ignore a signal to stop, the brake is automatically tripped and the train brought to a standstill. The train may be run from any motor car, or any motor car may be cut out and used as a trailer. The wiring insulation is as nearly perfect as it can be made, and the steel cars are fireproof.

The prospective motorman is thoroughly drilled in the school car by a competent instructor not only in use of the mechanism but also how to act in cases of emergency. This personal teaching is supplemented by an excellent book of instructions containing about 150 questions and answers of a practical nature, with cuts and explanations of all the apparatus. This the motorman is expected to study closely and thoroughly. From time to time his knowledge of its contents is tested in examinations. Should he be of an inquiring turn of mind he is further allowed the privilege and opportunity of entering the shops and studying the entire system in detail, as much as he desires.

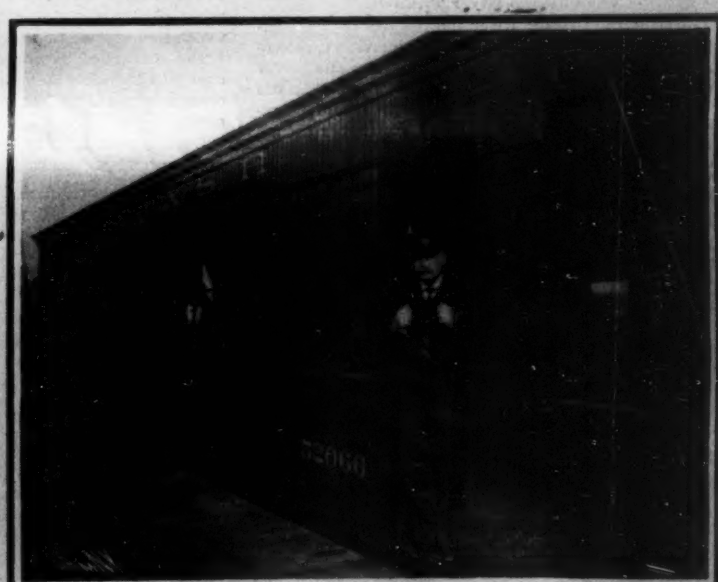
SIDE-DOOR COACHES FOR WORLD'S FAIR SERVICE.

BY CHARLES ALMA BYERS.

The use of side-door coaches for quick service on railroads is rapidly growing into popularity. The advantages pointed out some time ago by the SCIENTIFIC AMERICAN of side doors for passenger coaches over end doors have been fully realized. Actual experiments have clearly shown the theory that a train of coaches thus constructed can handle a crowd of passengers much more quickly to be absolutely practical. The first real test of this theory was made by the Illinois Central Railroad at the Chicago Exposition in 1893. That experiment proved satisfactory in every way, and as a consequence the Wabash Company has followed suit by using coaches of such construction for its shuttle trains between the Union Station and the World's Fair grounds at St. Louis. The construction of the Wabash's side-door coaches, however, differs slightly from that of those used by the Illinois Central. This difference is noticeable mainly on the interior. Instead of an aisle on each side, there is only one through the center, as in the ordinary coach. This is probably an improvement so far as affording more space for seats is concerned, but the plan undoubtedly detracts from the real object of the side doors—that is, of allowing the cars to be the most quickly filled and emptied. Another difference is that the Wabash's coaches have only four doors on each side, or eight in all, while those used by the Illinois Central had ten to the side, or a total of twenty. This is also a feature in which the Illinois Central surpassed in the matter of constructing a coach so as to be more quickly filled and emptied. Nevertheless, the time which is required for filling or emptying a Wabash coach of passengers is remarkably short as compared with the ordinarily constructed car.

The length of the Wabash coach is 50 feet and its seating capacity 92. Straps, however, are provided for standing passengers, as in a street car, and if neces-

Interior of the Side-Door Car.



View Showing Side Doors and the Lever by Which They Are Opened.

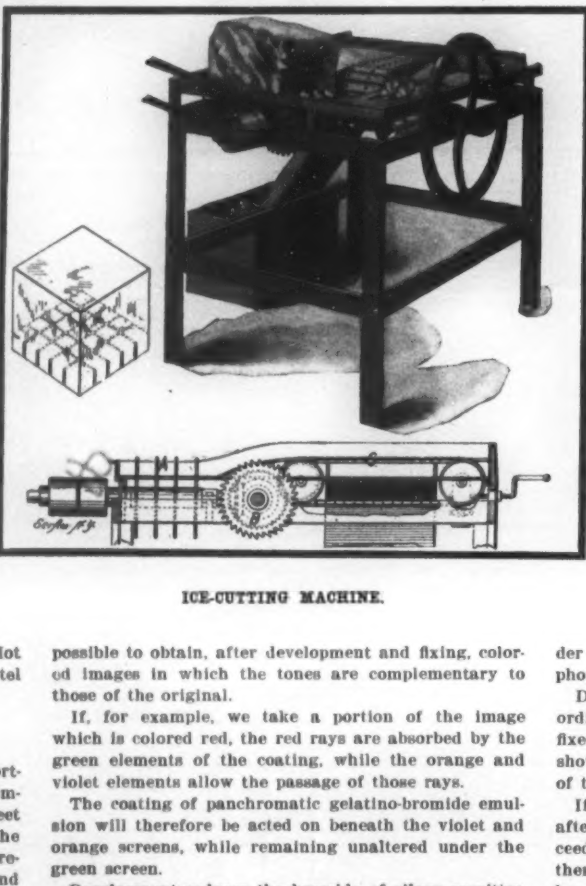
SIDE-DOOR COACHES FOR WORLD'S FAIR SERVICE.

sary one can be made to accommodate as many as 120 persons. The doors are so arranged that all are opened together by one move of a lever, but are closed separately. The platforms at the stations being level with the floor of the coach, no steps are necessary, and consequently much time is saved in this way. These cars have been especially constructed for World's Fair service, but I am told it is the intention of the company to convert them into furniture cars as soon as the Exposition closes. On this account the springs first put under the coaches were made too strong, and the temporary abandonment of the use of the cars for a few days has therefore been made necessary in order to remove a couple of leaves and make them weaker.

For their shuttle-train service at St. Louis the Wabash has a double track running all the way from the Union Station to the World's Fair grounds; and, with the exception of a short distance, these tracks are provided with automatic electric block signals every 1,200 feet. Fifteen minutes is the time required for a one-way trip, and at present the trains are being run each way fifteen minutes apart. If at any time, however, the business demands it they may be run every five minutes. Each train may contain as many as ten coaches, and if thus forced to the limit it is possible for the system easily to handle 25,000 an hour. The total number of persons handled by the Wabash on the opening day of the Exposition was a little over 17,000, and consequently it will be seen that a rush is not apt to occur. The number of side-door coaches constructed for the system is 150.

ICE-CUTTING MACHINE.

Pictured in the accompanying engraving is a machine for cutting blocks of ice into small pieces for use in hotels and other establishments. The machine will be found very useful, owing to its arrangement, which permits of quick and convenient handling of the block during the cutting operation. The machine comprises a feeding table over which the block of ice is moved to successively engage the cutting devices. These consist of gangs of circular saws on shafts disposed at right angles to each other, and thus adapted to make intersecting cuts in the ice block. The ice block is first moved against the saws shown at *A* in the illustration, which make a series of parallel cuts in the block, and then against the saws shown at *B*, which make a series of parallel cuts intersecting the first series. The ice then presents the appearance shown in our detail view. The block is now moved against a horizontal band or link saw which makes a horizontal cut, cutting off the cubes formed by the previous saw cuts. These cubes drop into a chute which conveys them to a suitable receptacle. The main body of the ice block, however, slides over the band saw, ready to be moved again against the gang saws at *A*. The process is then repeated until the entire block has been cut up into small cubes. The machine is provided with fast and loose pulleys, which carry the belt that drives the cutting mechanism. The shafts which carry the gang saws are geared together and also to the pulleys of the band saw so that all the saws turn in unison. A patent on this machine has been secured by Robert Mowery, Hot Springs, Ark., and John D. Tellman, care of Hotel Jefferson, St. Louis, Mo.



ICE-CUTTING MACHINE.

The Chicago River Tunnels.

Lowering the Chicago River tunnels has been reported on by Col. O. H. Ernst, U. S. Engineers. He recommends that the Washington Street and La Salle Street tunnels be lowered to give a depth of 26 feet in the river, on the ground that such a depth would be required to carry 8,000 cubic feet of water per second without making a too rapid current. This amount of water must ultimately flow through the river to the drainage canal. The time for completing the work is to be limited to May 1, 1907, but the tunnels are to be removed so that half of the channel shall be open to navigation by April 1, 1905, says Engineering News. It will be necessary to abandon these tunnels at once, and cofferdams will have to be built to the center of the river, enabling the contractor to build half of the new tunnel while leaving the other half of the stream free to navigation. Regarding the Van Buren Street tunnel, Col. Ernst reports that no cofferdam work will be necessary and the reconstruction may be carried on without interfering with the use of the tunnel.

Death of Prof. Ratzel.

Prof. Friedrich Ratzel died on August 9. He is best known to Americans by his splendid work, "The United States of North America," in which he exhaustively studied the natural resources of the United States and their relation to its population. His work on "The Political Geography of the United States" and many other works of an ethnological and geographical character are likewise well known.

THE DIRECT PRODUCTION OF PHOTOGRAPHS IN COLORS BY A NEW METHOD.

Messrs. August and Louis Lumiere, the well-known French experimenters and manufacturers in photographic products, have recently described in a communication to Focus their latest experiments toward the attainment of direct colored images by photography, which are novel. The method is based on the following theories:

If a collection of microscopic elements, of a transparent nature and colored respectively red-orange, green, and violet, be spread on the surface of a glass plate in the form of a single thin coating, it will be found, if the intensities of coloration of these elements and their number be correct, that the coating so made does not appear colored when examined by transmitted light, and also that this coating absorbs a fraction only of the light transmitted.

The light rays in passing through the elementary screens, orange, green, and violet, reconstruct white light, if the number of surfaces or elementary screens for each color, and the depth of coloration of these, are in accordance with the relative proportions of those which are found in white light.

This thin trichromatic coating being formed is then coated with a sensitive panchromatic emulsion. If the plate so prepared is submitted to the action of a colored image, taking the precaution to expose through the back of the plate, the luminous rays pass through the elementary screens, and undergo, according to their color and the screens they encounter, a variable absorption before having any influence on the sensitive coating.

By this means a color selection should be effected by means of the microscopic elements and making it possible to obtain, after development and fixing, colored images in which the tones are complementary to those of the original.

If, for example, we take a portion of the image which is colored red, the red rays are absorbed by the green elements of the coating, while the orange and violet elements allow the passage of those rays.

The coating of panchromatic gelatino-bromide emulsion will therefore be acted on beneath the violet and orange screens, while remaining unaltered under the green screen.

Development reduces the bromide of silver sensitive coating, and so masks the orange and violet portions of the image, while the green portions appear after the plate is fixed, because the emulsion covering them has not received light action, and so is transparent after fixing; the result obtained in this case is therefore of a green color, which is complementary to the red rays dealt with. Similar phenomena are produced with other colors, as, under the action of green light the green screens are masked, and the coating would appear of a red color; with the use of yellow light the image would appear violet, and so on in like manner with other colors.

It follows that with a negative showing complementary colors obtained in this way it is possible to obtain, with plates prepared in this manner, positive prints which will be complementary to the negatives, i. e., reproducing the colors of the original.

Also, after development, and before fixing of the negative image, that image may be reversed, and, by the known processes, a positive image may be obtained, showing the colors of the object photographed.

The difficulties we have met in the application of this method are numerous and considerable, but the results obtained show that those difficulties may be overcome. It will suffice if we indicate a few of the more important conditions, showing the delicacy of the problem before us.

A coating must be prepared, formed of microscopic screens, orange, green, and violet, which coating it is necessary should adhere to its support and be extremely thin, that the coloration of these microscopic elements or screens should be exactly determined as regards intensity, quality of color, and the number of elements of each kind. It is also necessary that these colors should be stable, that they do not diffuse, and that there is no superposition of color screens or elements, nor gaps between them.

It is further essential that the photographic sensitive emulsion should be orthochromatized in a manner which shall not falsify colors, and that this orthochromatism should be in relation to the nature of the emulsion and the colors of the elementary screens. This coating of emulsion must also be of a special nature to avoid diffusion, and the manipulations, development, exposure, etc., must be of a nature suitable to these preparations. The simple enumeration of some of the conditions necessary to be filled shows how essential are care and method to the success of such processes.

This research is not entirely finished, but we indicate hereunder the practical position to which we have brought the process at the moment. We first separate in potato starch, and by the aid of apparatus made for this purpose, the grains having a diameter of from the fifteen-thousandth to the twenty-thousandth of a millimeter. These grains are divided into three parts, and colored respectively red-orange, green, and violet, by the use of special coloring matters, and by a process too prolonged to describe here.

The colored powders so obtained are mixed, after complete desiccation, in such proportions that the mixture shows no dominant tint. The resulting powder is spread by a brush on a sheet of glass covered with an adherent or sticky coating.

With suitable precautions we obtain a single coating of grains all touching and without superposition. We then stop, by the same process of powdering, the spaces which may exist between the grains, and which would allow the passage of white light. This stopping is accomplished by the use of a very fine black powder, as for example, charcoal.

We have by these methods formed a screen in which each square millimeter of surface represents two or three thousand small elementary screens of orange, green, and violet. The surface so prepared is isolated by a varnish possessing an index of refraction as near as possible that of starch. This varnish must also be as impermeable as possible, as it is coated with a thin layer of panchromatic gelatino-bromide emulsion. Exposure is made in the ordinary manner, in a photographic camera, taking the precaution always to turn the glass side of the plate to the lens, in order that the light may pass through the color particles before reaching the sensitive emulsion.

The necessity of employing emulsions of an extremely fine grain, and in consequence of a lower speed, and the superposition of a coating formed of a system of microscopic screens, render the necessary exposure longer than for ordinary photography.

Development is performed in the same manner as ordinarily, but as we have said, if the negative be fixed with hyposulphite, a negative is obtained which shows by transparence colors complementary to those of the object photographed.

If it is desired to obtain correct colors, we must, after development, but without fixing the image, proceed to reverse it by dissolving the reduced silver, and then by a second development reduce the silver which has not been primarily acted on by the light.

We see then that by simple manipulations little different from those used in ordinary photography, it is possible to obtain with these special plates, prepared as indicated, the reproduction, by means of a single plate and a single exposure, of objects in their natural colors.

A breach has been made in the Manchester Ship Canal at Runcorn, and when the tide is out water pours into the bed of the river Mersey at the rate of 70,000 to 100,000 gallons per hour. As, however, the tide sweeps into the canal twice in every twenty-four hours, no appreciable difference appears to be made in the level of the waterway. The danger lies in the possible undermining of the wall at this point. The "burst" has occurred at a point where there was experienced great difficulty in building the wall.

At the Kleinfontein shaft, in the Transvaal, 858 feet of sinking was done in the first five months of 1903. The dimensions were 21 feet by 6 feet, the rock was hard, and the maximum rate of progress in May was 7 feet 2.2 inches per hole bored, there being 4,032 holes, or 144 rounds.

Correspondence.

The Trap-Door Spider.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of the 30th July, is an article by C. E. Hutchinson, on "A Trap-Door Spider," placing its habitat in California. It has always seemed strange to me that this spider is assigned to the Pacific Coast when I know that it is found in numbers, at least in one place, on the Atlantic Coast.

Upon what used to be known as the Tidyman plantation (The Marsh), on Minim Creek, North Santee, South Carolina, when I was a boy, about the years 1850-1860, there were many of these trap-door spiders; and I must say that this is the only place where I have ever seen them. In front of the house there was an open grass-covered lawn of perhaps four or more acres, and many times I have amused myself hunting for the trap-doors of the spiders' tunnels. And I well recollect how interested I have been at the strength of the spiders in holding the doors shut as I attempted to open them. My recollection is that the spiders were stout, and possibly ⅝-inch long; and that the tunnels were about ⅝ inch, or ¾ inch in diameter. Forty-four years have passed since I have been on the grounds, but the trap-door spiders were there at that time, and probably are there still.

This is why I have always been surprised to see this spider invariably written of as a native of California.

ARTHUR P. FORD.

Aiken, S. C., August 9, 1904.

Is Electricity as a Motive Power Unhealthful?

To the Editor of the SCIENTIFIC AMERICAN:

Anent the very pertinent question raised by Mr. Albert W. Dennis, in your issue of July 30, in an article entitled "Are Pressmen Affected by Electricity from the Belts?" the inference drawn from Mr. Dennis' observations and remarks would be that electricity as a motive power is unhealthful for the operatives, and others who, from choice or duty, remain near the belts or motors charged or driven with or by electricity.

As one of the pioneers in the electric field, I could not for a moment allow this impression to go abroad unchallenged.

It is clear that Mr. Dennis is a close observer, and has the welfare of his employes at heart. Both of these traits are in the highest degree commendable. It is also clear to any one at all familiar with the practical operation of electrically-driven plants, that one of three things must be the matter.

First. If the electricity carried by the belts escapes from the motor the insulation is defective, and needs immediate attention, to save waste of current and loss of power.

Second. If the current does not escape from the motor, but on the other hand it is frictional electricity with which the belts are charged, it is clear that the belts are slipping, with a resultant loss of travel and power, and they should be tightened until the vagrant current disappears. If it is not convenient to tighten the belts to a point where the generation of current ceases a pulley cover of rubber applied to the face of the pulleys would be advisable.

Third. If the motor is hot enough "so that the atmosphere always seems to be hot and surcharged so as to induce a sort of feverish feeling about the temples, etc.," as Mr. Dennis describes, it is clear that the motor is overloaded, as the resultant heat from a motor suited to its load should be nil. After remedying the electrical discharges, and other troubles as above outlined, Mr. Dennis will probably find that it is lack of ventilation and not electrical troubles his people have been suffering from. The homeopathic doses of magnetism or electricity one would be able to receive in a few minutes' stay in a press-room as described, would be too infinitesimal to be appreciable and certainly not so liable to cause nausea as a combination of hot air, printers' ink, and machine oil in a poorly-ventilated room.

That the magnetic influence of motors operated in close proximity to the human body from day to day for long periods under proper conditions is of great benefit to the person so brought within its influence, is the firm belief of the writer, and he has yet to see, in nearly twenty years' experience and observation in the various fields of electrical work, a single instance where it was not beneficial. When Leo Daft, Thomas Edison, Vanderpole, and F. J. Sprague began the crusade (along different lines but all leading to the same end) which led up to the abandonment of the hay motor (mules and horses), in favor of electric traction, and incidentally the adoption of the electric motor for all kinds of motive power, there was no other school than experiment and observation in which to learn the mysteries of the subtle fluid, consequently many of us were graduated from it.

The writer well remembers the many cats killed by the electric cars on the first roads equipped, while taking their evening electrical bath by rolling along between the rails of the road bed.

Pussy, like man, has grown wise to the fact that the cars sometimes kill, and while she may yet be seen in the early evening disporting herself near the rails it is rare indeed nowadays to find one which has been killed by the cars on the older roads. The writer having been a horse-car man previous to the advent of electric traction, was quick to note the antics of the cats, and was led to investigate the influence of electric traction on man. After transforming several horse-car lines to electric lines, and converting the drivers into motormen, it was noted that invariably the health of the men began to improve and they began to take on flesh. As they were running over the same route as formerly, and were exposed to the same weather conditions (the vestibule not having been invented), there was no way to account for improved health, snap, and vigor, except as the result of the imperceptible magnetism of the motors, or the proximity of heavy electric currents.

While the writer was superintendent of the San Antonio (Tex.) Street Railway in the early nineties he called the attention of Dr. F. M. Hicks, the company's surgeon (and one of the most noted practitioners of Texas to-day), to his observations as above. Shortly afterward Dr. Hicks requested me to take on two consumptive citizens from Illinois as motormen. They were accordingly installed, and in a few months were both apparently restored to robust health. It is true that San Antonio is a healthy resort for this type of disease, and if there was no sequel to my story it would lose its point. Now for the sequel! After about two years' service one of these left the employ of the electric railway and retired to a farm on the outskirts of the city; within a year his disease returned and he died. The other continued in the service for several years, and when the writer saw him last, he seemed still to be in the same robust health; he informed me, however, that he quit the road for about six months, at one time, and returning ill health warned him to again go back to the service, which he did and is now at work in Houston. Another horse-car conductor in a poor state of health was changed to the electric cars and after running for two years his highly nervous, emaciated form had rounded out to magnificent proportions at the time he left the service to embark in the cattle and horse business. In less than two years after abandoning the motor cars he died from nervous debility and exhaustion. An engineer from Indianapolis, Indiana, who came south for his health, was recommended by the writer and put in charge of the press-room plant of the Daily Express operated by electric motors. The Daily Express building is a magnificent example of the modern publishing house, and its press-rooms as well as all other parts of the building is thoroughly ventilated, and although the work was wholly night work, and he was thrown continually in close proximity to the motors, belts and presses, of such an establishment, in two years he was thoroughly sound and well, and returned to the north to again take up his occupation of steam engineer.

Many instances could be cited and substantiated of the above nature which have come under the observation of the writer if space permitted, but as it does not I will content myself by calling attention to the fact that the census reports show that during the last decade the health of the principal cities greatly improved and the death rate was considerably lower than formerly.

As the period between 1890 and 1900 witnessed the almost universal adoption of electric traction, and the electric motor in our cities, and millions of our citizens were thrown within the gentle and stimulating (although imperceptible) influence of the motors in their daily rides on the cars, or in the various occupations operated by motors—is it not worth while to consider whether or not the adoption of electricity as a motive power has not had as much to do with improved health conditions in our cities as "improved sanitation," which is usually given all the credit?

J. W. GREER.

Yoakum, Tex., August 2, 1904.

The Current Supplement.

The current SUPPLEMENT, No. 1495, opens with a splendid picture of an exhibit of rock and ore crushing and screening machinery in the Mines Building at the St. Louis fair. The St. Louis correspondent of the SCIENTIFIC AMERICAN describes the machinery briefly yet clearly. From the same pen is published an illustrated article on "Geronimo" and an account of the 1,000-horse-power compound French engine and dynamo at the fair. An excellent picture of the engine in question also appears. An article entitled "The Aeroplane" by M. Rudolphe Sorean, outlines some of the difficulties met with in the construction of an aeroplane flying machine. George E. Walsh writes instructively on "Briquette Fuel Materials." "Sewage Purification" is the title of an article by C. M. Ginther, which is excellently illustrated. Emile Guarini writes on the Krieger electric automobile. Very few are aware of the notable service rendered to farmers and gardeners throughout the entire growing season by the common toad. The usefulness of this despised animal is eloquently set forth by A. H. Kirkland. The report of Mr. W. Ripper, of the University of Sheffield, on observations of the Mosely Educational Commission, begins in the current SUPPLEMENT. Of electrical interest are articles on some new experiments with cathode rays and the Janus telephone system.

Calxia.

Calxia is a new substance destined to take the place of terra cotta and plaster in the majority of their applications, principally with regard to the manufacture of small objects and the covering of surfaces of moderate size.

The various ingredients that enter into its composition impart to it remarkable hardness and cohesion and at the same time great plasticity.

The proportions are as follows:

Water	30 parts
Albumen	10 parts
Sulphate of magnesia	4 parts
Alum	9 parts
Sulphate of calcium, roasted	45 parts
Borax	2 parts
	100 parts

The preparation of the mixture must be conducted with great exactness, otherwise it will lose some of its qualities. First dissolve 10 parts of albumen and 9 parts of feather alum in 30 parts of water, which liquid is used for mixing to a convenient consistency, 45 parts of burnt sulphate of calcium, 4 of sulphate of magnesia and 2 of borax. The product obtained is a paste which is molded by the usual processes. As soon as it has "set" it is placed in a stove at 60 deg. C. It is very important not to exceed this temperature, otherwise the composition will crumble. In order to increase its hardness and to render it inalterable in the air, it is well to plunge it for a minute into a receptacle heated in the water-bath and containing oil boiled with litharge with Carnauba wax added. Then it is again put in the stove to be dried at a temperature of only 35 deg. C. Heat and humidity have after that no more effect on it.

It is easy to give to the piece thus obtained the shades of fired stoneware by coating it with a solution of alcohol and sandarac and sprinkling on powdered sandstone when it is still fresh. The light parts of the color are done with liquid enamels applied cold and placed in the stove at 60 deg. C. The tints are unalterable and adhere very firmly. Any desired effect may be produced and veritable objects of art be created bearing the imprint of the personal taste of the maker and adaptable to decoration in all imaginable forms. These manipulations are productive of appreciable advantages. First of all, this material possesses great solidity, which enables it to withstand shocks which would be fatal to plaster and terra cotta. Nevertheless, it is very light and this fact is of interest when it comes to ornamenting interiors by means of statues, bas-reliefs, friezes, cornices, and various applications, whose weight must needs be limited.

Its great resistance to flexion and traction is utilized in the manufacture of consoles, sockets, pedestals, socles, and tablets destined to support considerable weight.

Finally, a very important advantage possessed by the new substance should be noted, viz., its imperviousness to hot and caustic solutions. At an epoch where antiseptics are more and more becoming the order of the day and dust is pursued by all available means it is indispensable to be able to decorate interiors with objects or applications which can be asepticized frequently and in a thorough fashion. In conclusion, let us state that the low price of the raw materials and the simplicity of the manipulations, which anybody can carry out, reduce the cost of calxia to one-half of that of terra cotta.—La Nature.

Twenty-four ovens in the new Semet-Solvay plant of the Milwaukee Coke and Gas Company have begun operation, and the remaining fifty-six will be started soon. Each of the ovens requires, every twenty-four hours, 7.5 tons of coal, and the product of the twenty-four ovens now runs to about 130 tons of coke a day. When the eighty ovens are in operation, the daily product will be between 450 and 500 tons. The gas now generated by the ovens is being used to heat the newer ones, but there will be a surplus of about 3,000,000 cubic feet a day, of which the company desires to dispose.

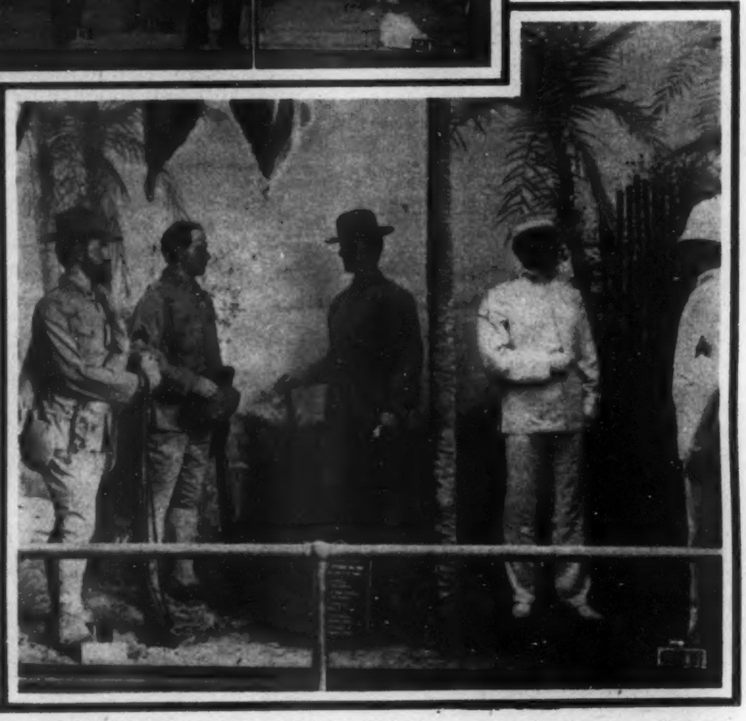
The number of furnaces in blast in the United Kingdom for the quarter ended June 30 last was 329, and the estimated make of pig iron for the half-year is 4,218,000 tons.

WAR DEPARTMENT EXHIBIT AT THE ST. LOUIS FAIR.

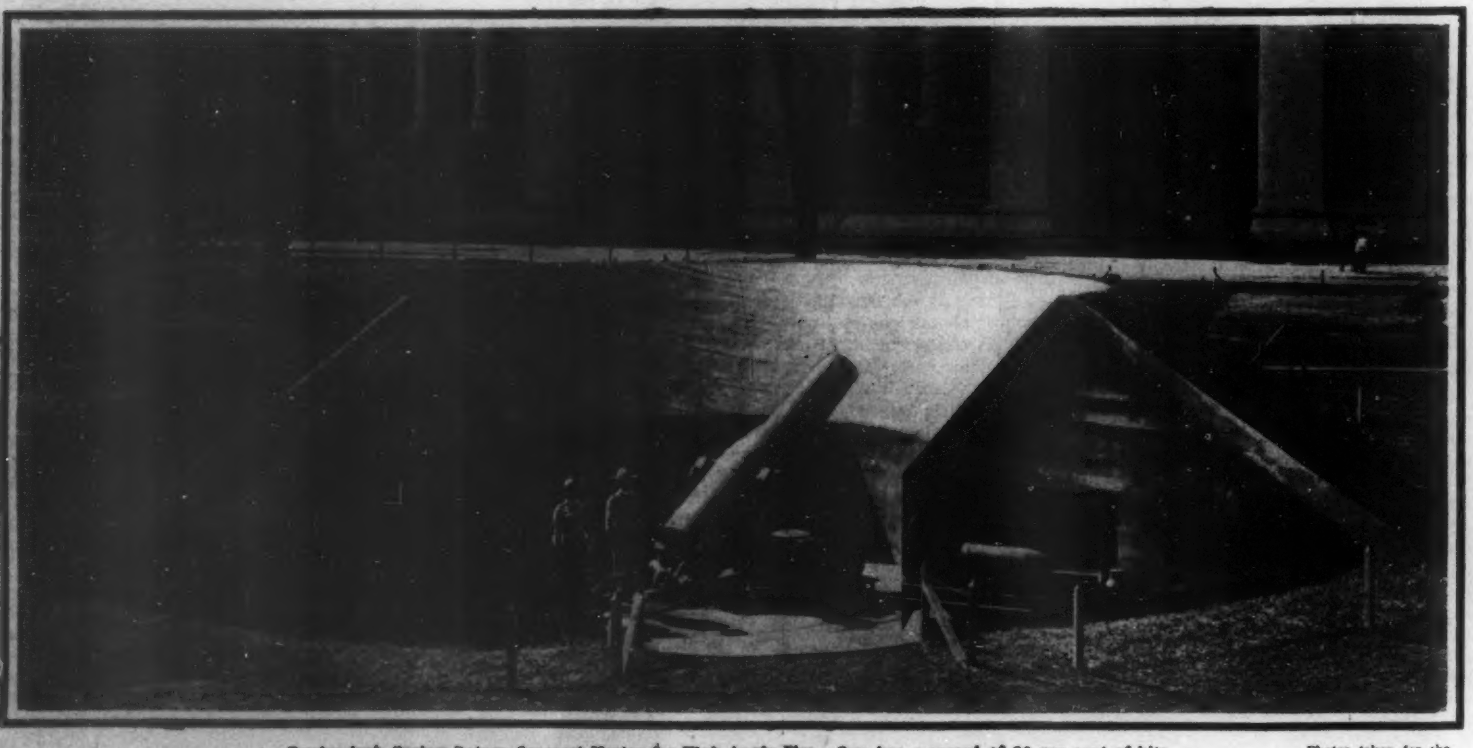
BY THE ST. LOUIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The character of the displays which have been made by the United States government at previous expositions led the public to expect that the government exhibit at the present World's Fair at St. Louis would be exceptionally fine. The truly magnificent building of the government, with the very fine collection of exhibits within the building and surrounding it, have amply justified the expectation. Of the many departments that are represented, each in its own section of the building, perhaps the most popular and certainly the most striking is that shown by the War Department; and of the various elements of its display, the most attractive is the series of reproductions of coast defenses that are arranged around the western end of the main building. Facing the northwestern angle of the building are two emplacements—two reproductions of the actual fortifications—representing two disappearing guns in their emplacements, one a 50-caliber, 6-inch, and the other, illustrated on our front page, a 42-caliber, 12-inch rifle. The 12-inch rifle, which was recently completed at the gun shops, is one of the model of 1900. The gun itself, which weighs 131,500 pounds, cost $43,451 to construct. It is mounted on a Buffington-Crozier disappearing carriage, which embodies the latest improvements of the type. The carriage with its gear weighs 411,826 pounds, and it cost nearly as much as the gun to construct, or $41,000. The gun fires a 1,000-pound shell, with a muzzle velocity of 22,000 feet per second, and it has an extreme theoretical range (which, of course, will never be used in practice) of 18 miles. This type of gun and mount has shown very good results in target practice; as at Fort Greble, R. I., where four shots were fired within five minutes, with four perfect hits. Another gun of the type fired five shots in four minutes and thirty-nine seconds during practice at Fortress Monroe, Va.

This type of disappearing gun carriage has been so fully illustrated in the Scientific American that no extended description is necessary here. In the front-page engraving the gun is shown in the firing position and, therefore, above the parapet. Normally the gun lies in the depressed position and entirely within the shelter of the parapet, where it is loaded and sighted, the range being telephoned to the gunners from some distant point of observation in which the range finder is concealed. As soon as the gun is ready for firing, it is raised to the firing position by means of heavy counterweights, which are attached to the lower ends of a heavy pair of cast-steel pivoted arms, in the up-



Groups of Thirty-three Lifelike Lay Figures, Showing the Uniforms of Officers and Men of the United States Army. To left and right the lower cuts show the uniforms worn in the Arctics and tropics respectively.



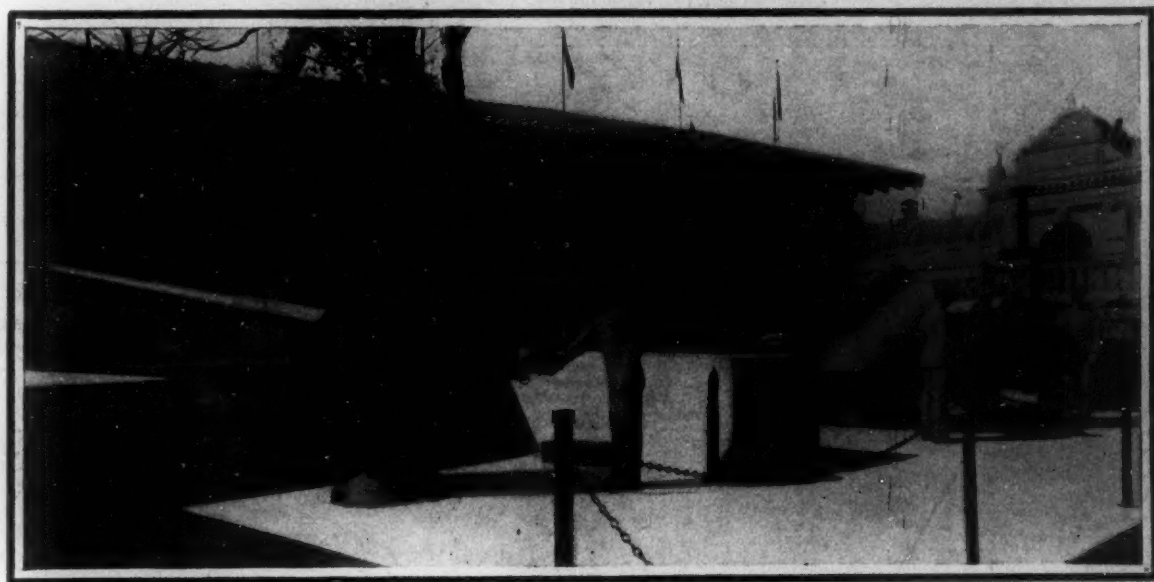
Twelve-inch Spring-Return Seacoast Mortar for High-Angle Fire. Gun has a record of 30 per cent of hits.

Photos taken for the Scientific American.

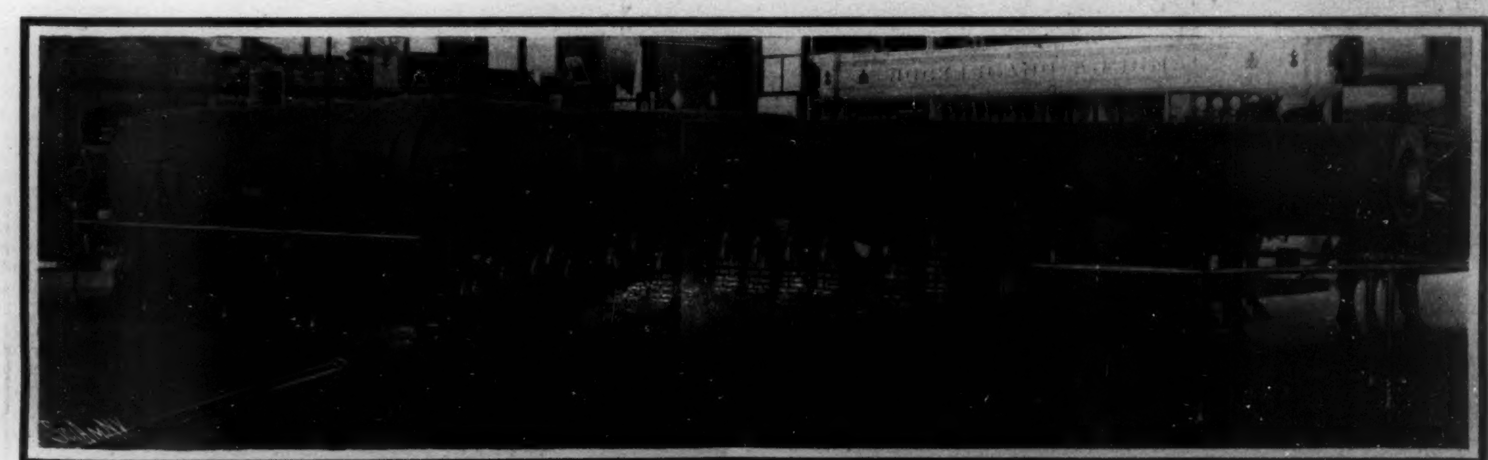
UNITED STATES WAR DEPARTMENT EXHIBIT AT ST. LOUIS FAIR.

per end of which rest the trunnions of the gun. When the piece is fired the energy of the recoil is sufficient to throw the gun backward and downward into the loading position. The traversing, elevating, and depressing of the gun are accomplished by means of electric motors, the controllers of which are seen in the bottom left-hand corner of the cut.

In addition to the two disappearing guns above mentioned, the outside exhibit includes a 12-inch breech-loading mortar, mounted in its carriage and shown in a reproduction of a mortar pit. In service this type of gun is used for attacking warships, whether they are at anchor or in motion, at ranges between 3,000 and 12,000 yards. The mortar is entirely hidden in its deep emplacement and being elevated skyward, its shell is thrown several miles into the air and falls, literally "a bolt from the blue" upon the deck of the enemy. Side by side on another platform are a 7-inch breech-loading Howitzer and a 7-inch breech-loading mortar. The Howitzer, which is mounted on its carriage, represents a type of cannon used in siege operations against fortified places; while the field mortar is used exclusively for high-angle fire. On another platform is a 15-pounder, 3-inch rapid-fire gun, mounted on a barbette carriage, the province of this type of gun being to attack the superstructure of ships that may attempt to run past fortifications, and to protect submarine mine fields against the operations of the enemy. Adjoining the 15-pounder is a 6-inch 50-caliber rapid-fire gun, mounted on a pivotal barbette carriage provided with a new type of curved shield, which is finding considerable favor in the army. One of the most interesting features of this outside display of the Ordnance Department is the daily practice with the disappearing guns by detachments of sea-coast artillerymen. The whole process of loading, sighting, and firing the guns is gone through exactly as it would be



Three-inch 15-pounder Gun to left; 6-inch, 50-caliber Gun, with New Type of Curved Shield, to Right, shown in barbette emplacements. These are the latest patterns of army guns.



Model of 16-inch Army Gun, with Row of Projectiles and Powder Charges for 6-inch to 12-inch Guns. Weight of 16-inch Gun is 130 Tons; Muzzle Velocity, 23,000 feet per Second, and Maximum Range 21 Miles.

UNITED STATES WAR DEPARTMENT EXHIBIT AT ST. LOUIS FAIR.

in war-time operations. The outside exhibit also includes the famous 12-inch Krupp plate which was smashed to pieces in the recent attack upon it by high explosive shells filled with maximite and dunnite.

The most striking feature of the indoor exhibit of the War Department is an exact model of the great 16-inch coast-defense gun which was tested recently at Sandy Hook. This gun, which weighs 130 tons, throws a 2,400-pound shell with a muzzle velocity of 2,300 feet a second. If it were set up at the Battery and fired with an elevation of 45 degrees, the shell would land at Hastings-on-the-Hudson, 21 miles distance from the Battery. Alongside the gun are arranged samples of the projectiles and powder charges used in the army guns of from 6-inch to 12-inch caliber.

The Quartermaster's contribution to the exhibit is three cases containing full-sized models dressed in the various uniforms worn by the officers and men of the United States Army. The case to the left represents the clothing of furs, skins, etc., worn in the Arctics, the case to the right exhibits the light tropical dress, and the center case, which is the largest and handsomest of the three, shows the various uniforms in use both by mounted and infantry troops. It should be mentioned that these figures are so perfectly modeled and are given such a natural coloring, that at first sight one can easily be deceived into believing that the models are live men instead of lay figures.

The interior exhibit includes a mountain gun and equipment packed for transportation on five lay figures of pack mules, while another of these guns is shown assembled on its carriage ready for firing. A similar exhibit is made of a Colt automatic machine gun. Nearby there are a 3-inch rapid-fire field gun, a Vickers-Maxim automatic gun, and two Gatling guns, all mounted on their respective carriages. A particularly interesting feature is a series of fifteen machines, shown in operation, making ball cartridges for the army rifle. The Springfield armory exhibits, in a very interesting display, the development of portable firearms, from a small iron tube fired from a support by means of a lighted match held in the hand, to the latest pattern of army magazine rifle; while arranged on the wall is a series of pictures illustrating the various stages of the manufacture of the service rifle, the carbine, and the officers' sabre and cadet sword.

Other sections of the War Department are the Medical Department, with its fine exhibit of a brigade field hospital; the Corps of Engineers, with its splendid array of models relating to river and harbor improvements; the Signal Corps, with its exhibit of means for visual signaling; various types of telephones, the telautograph, the typewriting telegraph, the wireless telegraph, etc. The Artillery Corps has built a model tank, that attracts large crowds of the visitors to this building It contains a miniature mine field in which is shown a floating model of the man-of-war. The whole exhibit, which includes a full-sized submarine mine, possesses special interest at the present time, when this type of weapon is demonstrating its terrific powers. Mention should be made also of the West Point exhibit, rich in historic interest, and the very fine exhibits, chiefly by means of relief maps, of the various national military parks.

An interesting discovery of the remains of a prehistoric animal has been effected near Peterborough (England). While engaged in some excavations at a depth of twenty feet in the Oxford clay, some workmen alighted upon the huge head of a monster of the alligator genus. The jaws were two feet in length, and were firmly clenched together by the pressure of the earth through countless years. The bones, however, were in an excellent state of preservation. The creature has been determined as a member of the Steneosaurus family. Other interesting remains of a similar nature have also been unearthed in the same district.

A paper was read at the last meeting of the Paris Academy of Sciences on "The Action of Terrestrial Magnetism upon a Tube of Nickel Steel (Invar) Intended for Use as a Geodetic Pendulum," by M. G. Lippman. The alloy of nickel and iron known as invar, which possesses a coefficient of expansion only one-twentieth that of brass, has obvious advantages for pendulum observations. This steel, however, is magnetic, and it was thought possible that the disturbing influence introduced in this way might be too large to be neglected. The magnetic moment of a tube of this material was determined, and the possible error on a pendulum observation calculated. It was found to be negligible, and hence invar can be advantageously substituted for brass in the pendulum.

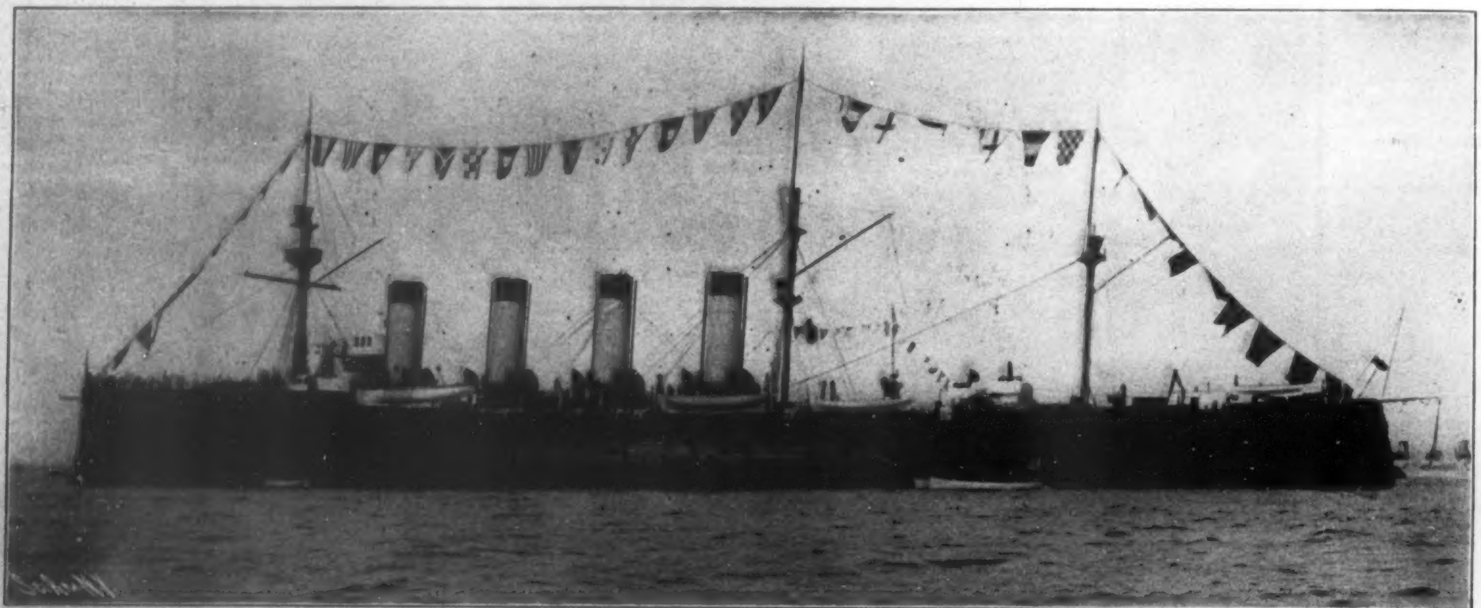
Fifteen electric clocks at Paris take their time from the Observatory; and M. Bigourdan has succeeded with a wireless telegraph station in transmitting the beats correctly to two or three thousandths of a second to telephone receivers with an area of two kilometers radius.

THE DEFEAT OF THE VLADIVOSTOCK SQUADRON.

It must have been with considerable satisfaction that Admiral Kamimura sighted at dawn on the morning of August 14, three of the illusive Vladivostock squadron steaming to the southward in the Strait of Korea; for herein lay his opportunity of forcing the enemy to combat, and proving to the over-zealous and not-too-discriminating Japanese patriots at home, that the Russian squadron was able to carry on its successful raiding of merchant ships only because Kamimura was tied down to the important duty of watching the narrow seas in which he finally intercepted and defeated the enemy.

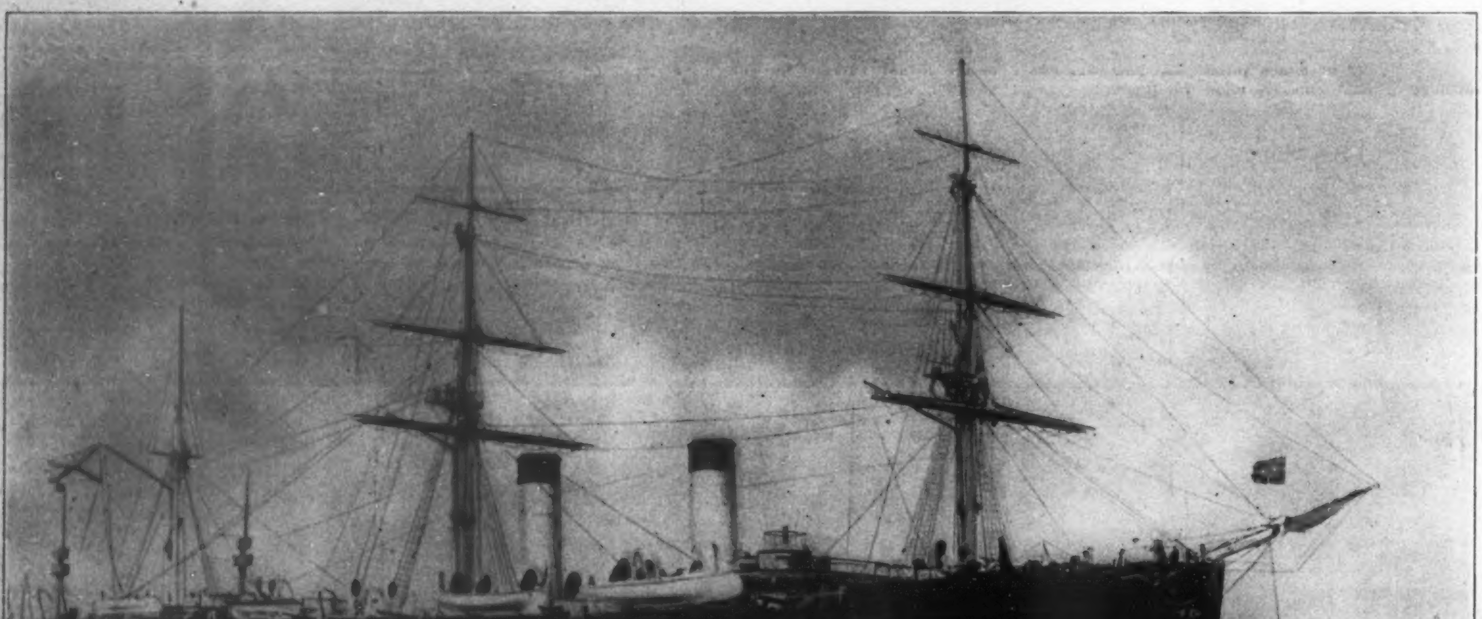
a part of her length, and her armor, although 10 inches thick at the water line, was of inferior quality compared to the splendid material with which all modern ships are protected. The other two armored cruisers were greatly superior to her. The "Rossia," built in 1896, is a vessel of 12,500 tons and about 20 knots speed, and she has the great advantage of being sheathed and coppered. Her main armament consists of four 8-inch guns of modern pattern, but her secondary armament, consisting of sixteen 5.5-inch guns, is altogether too light according to modern ideas, being effective only at close ranges. Her protection is good, consisting of a belt extending over the greater part of cruisers. All three ships were distinguished by their very numerous batteries, no other vessels in the world being so loaded with guns. Indeed, as the event has proved, they would have been far more effective ships had they carried fewer guns of greater weight and power.

Opposed to the Russians was a homogeneous fleet of four modern armored cruisers of practically the same size, speed, and armament. Three of them, the "Idzumo," "Iwate," and "Tokiwa," of about 9,800 tons displacement and 22 knots speed under forced draft, were built by Armstrong and carried guns of his make. The main armament consisted, in each case, of four



Displacement, 12,500 tons. **Speed,** 20.25 knots. **Coal Supply,** 2,500 tons and liquid fuel. **Armor:** Belt, 10 inches to 5 inches, upper belt, 4 inches, casemates 2 inches, screens, 2 inches. **Armament,** four 8-inch, sixteen 5.5-inch, twelve 3-inch, 36 smaller guns. **Torpedo tubes,** 6 above water. **Complement,** 735.

ARMORED CRUISER "ROSSIA," SEVERELY DAMAGED IN THE KOREA STRAIT ENGAGEMENT.



Displacement, 10,950 tons. **Speed,** 18.8 knots. **Coal Supply,** 2,000 tons. **Armor:** Belt, 10 inches to 5 inches; deck, 2½ inches; sponsons, 2 inches. **Armament:** four 8-inch, sixteen 5.5-inch; six 4.7-inch, 22 small guns. **Torpedo tubes,** 6 above water. **Complement,** 727.

RUSSIAN ARMORED CRUISER "RURIK," SUNK IN THE KOREA STRAIT ENGAGEMENT.

The Russian squadron was composed of three large armored cruisers, of which the oldest, the "Rurik," of about 11,000 tons displacement, was notable as having been the progenitor of the big, powerful, and fast armored cruisers which have become so popular in the present day. The "Rurik," built in 1892, must be called an old vessel; for her guns were of short caliber and low velocities; her speed, originally between 18 and 19 knots, had dropped to 15 knots or under (for not being wood-sheathed and coppered she naturally fouled rather quickly); her armor belt extended only the water-line, and composed of Harvey steel of a maximum thickness of 10 inches. The "Gromoboi," built in 1899, is a vessel of about the same tonnage, also sheathed and coppered, and having about the same speed, 20 knots an hour, as the "Rossia." Her main armament consists of four 8-inch or possibly 8.4-inch guns, and is greatly superior to that of the "Rossia" because of the fact that her secondary battery is made up of sixteen 6-inch guns, 45 calibers in length, which were available for effective work of much greater ranges than the rapid-fire guns of the other two 8-inch and fourteen 6-inch guns, and the vessels were protected with 7-inch Harvey nickel belts, with 6 inches of casemate protection for the guns. The fourth vessel of the squadron was the "Azuma," built at St. Nazaire, France. She is of 9,436 tons displacement, 21 knots speed and carries four 8-inch and twelve 6-inch guns as her main armament. Her belt is of Krupp steel, and she has 6 inches of Harvey nickel-steel protection for her guns.

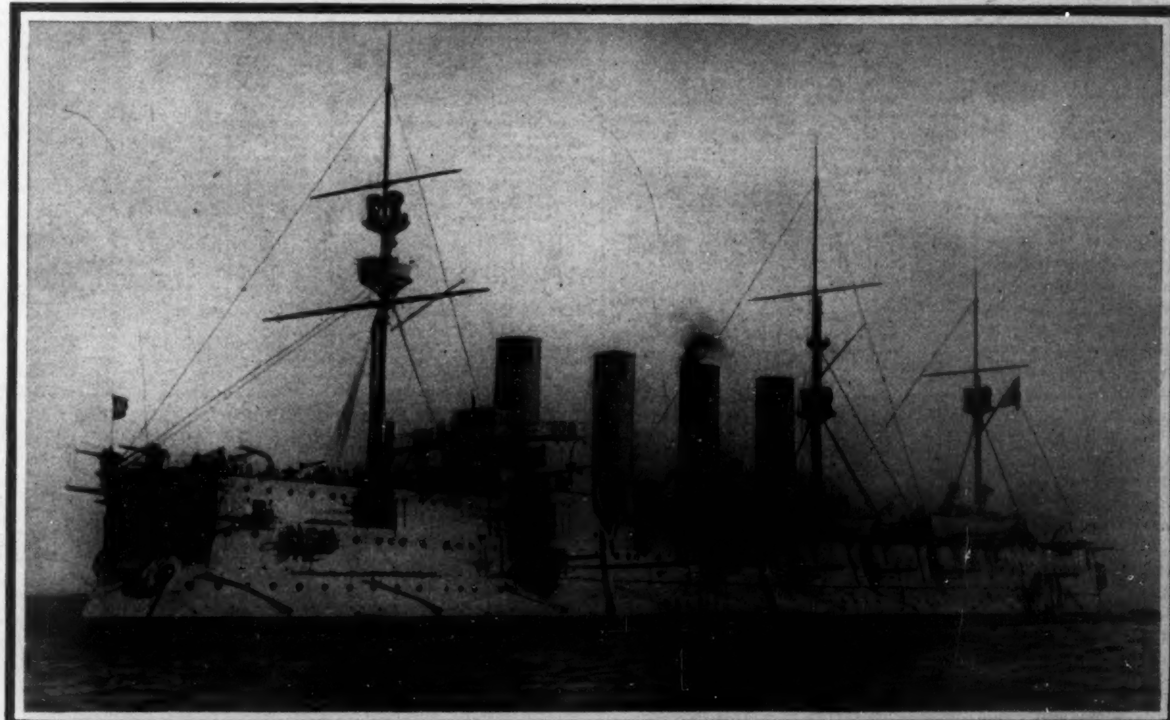
It should be mentioned that whereas the Japanese cruisers carried their armament in turrets or within

casemates, the Russian cruisers carried but few of their guns in casemates, most of the pieces depending upon gun shields for protection. The Japanese, in this fight as in that off Port Arthur a few days before, elected to make the conflict a battle between gunners. They appear to have remained at long range (though the reports of the Japanese and Russian admirals do not agree on this point), and trusted to their superior pieces and better gunnery to disable the enemy at the cost of a minimum amount of damage to themselves. This was obviously the proper course for the Japanese. Such fighting would have to be done mainly by the 8-inch and 6-inch guns, and of the 8-inch Russia possessed but twelve guns against sixteen carried by the Japanese; moreover four of those twelve were the short 30-caliber pieces of the "Rurik," whose velocity and range were very limited. Hence, in the earlier stages of the fight, the Japanese must have been able to reach the Russian ships with about twice the number of 8-inch pieces that the Russians could hope to make effective upon the Japanese ships. In the 6-inch pieces, the Japanese had a tremendous superiority, carrying fifty-four against the sixteen mounted by the "Gromoboi." The "Rossia" and the "Rurik," it is true, mounted sixteen 5.5-inch guns apiece; but the one-half inch drop in caliber means a big drop in striking energy and carrying power, and it is doubtful if the 5.5-inch guns were able to do much effective work in this long-range fight.

It is a question as to which squadron had the advantage in the matter of speed. For although the Japanese ships were credited with from 21 to 22 knots trial speed, they were not sheathed, and for some months they have been tied closely to the task of watching the Straits to prevent a junction of the Port Arthur and Vladivostock squadrons; hence their bottoms were probably very foul, and their speed not much better than that of the "Rurik," or, say,* about 15 knots an hour. The immense advantage of sheathing and coppering was shown at the close of the fight, when the "Gromoboi" and "Rossia," which should have been captured or sunk by the victorious Japanese, were able to draw away and make good their escape to Vladivostock.

There is no new lesson taught by the fight. We simply see the accepted theories of construction and tactics once more strongly verified. That the speed of the fleet is governed by the speed of the slowest ships was proved by the fact that the slower "Rurik" dropped behind and became the target for a terrific concentrated fire from the four Japanese cruisers; and although the two faster Russian ships repeatedly returned to her assistance, they were themselves so hard hit in doing this that they were forced to leave the "Rurik" to her fate. The superior armor carried by the newer Russian ships showed its value in protecting the water line from vital injury. The softer and less extensive water-line belt of the "Rurik" presented a weak point which the Japanese were quick to take advantage of. She was evidently so badly hulled that her ultimate sinking was only a question of time.

The two sheathed cruisers which escaped to Vladivostock present an interesting problem for the Japanese to solve. With their copper bottoms and with the large Vladivostock drydock available for cleaning, unless their engines have been seriously disabled, they can prey upon commerce without any fear of being captured for many months to come. For it is doubtful if there are any Japanese ships that can be put into condition to match them in speed. There can be little doubt that the experience of these ships will go far to enhance the value of the copper bottom in future warship construction.



Displacement, 12,367 tons. **Speed,** 20 knots. **Coal Supply,** 2,500 tons and liquid fuel. **Armor,** belt, 6-inch; deck, 2-inch; secondary belt, 4-inch; casemates, 6-inch. **Armament,** four 8-inch; sixteen 6-inch; twenty 3-inch; twenty-four small guns. **Torpedo Tubes,** four. **Complement,** 800.

ARMORED CRUISER "GROMOBOI," SEVERELY DAMAGED IN KOREA STRAIT ENGAGEMENT.

THE NEW BALDWIN AIRSHIP.

BY J. MAYNE BALTIMORE.

Capt. T. S. Baldwin, of Oakland, Cal., is the recent inventor and constructor of what proves to be a very successful dirigible airship.

The first and initial trial of the craft was made from Idora Park, Oakland. Since then several other trials have been made, all of which proved very satisfactory.

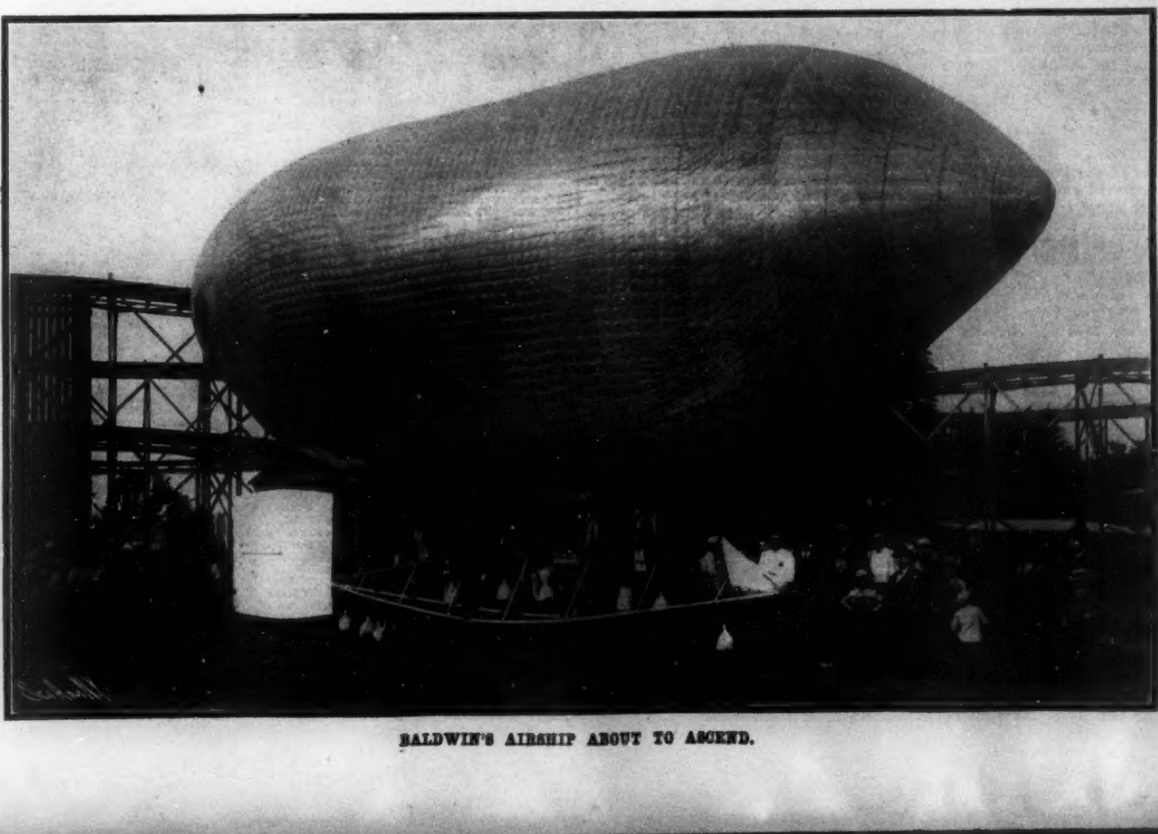
No high altitude was attained by the new airship. Capt. Baldwin's principal aim was to determine if the movements of his ship could be controlled. He ascertained that this could be done quite easily.

At a height of about 700 feet, he circled several times clear around the large park, going both against and with the wind, and moving at various angles. After being up nearly an hour, Capt. Baldwin brought his ship back to the starting point, and safely descended to earth. These trials were witnessed by great crowds of spectators.

Subsequent trials have also been made, when it was demonstrated that in every revolution of the large propeller, and in every move of the steering gear, and of the weights which raise or lower the vessel at will, the plans of the inventor have been carried into effect. The large propeller, having two metallic blades, and nearly 6 feet in diameter, instead of being placed at the stern, is located at the bow of the frame or car, as in most recent airships of this type. In this manner the airship, instead of being pushed through the air, is pulled. This facilitates the steering as well as raising or lowering the ship.

The balloon, by means of which the whole machine is raised, is somewhat blunt cigar-shaped. It measures 54 feet in length and is 17 feet in diameter in the middle. The balloon is constructed of a very fine quality of silk, extremely strong and flexible, and with the reticulated netting which attaches it to the car, weighs only 90 pounds. The balloon is inflated with hydrogen gas, and at an ordinary distension pressure contains 8,000 cubic feet.

To this balloon is attached the frame which supports the propelling and steering mechanism. This frame, which is made of



BALDWIN'S AIRSHIP ABOUT TO ASCEND.

strong, light wood, is triangular in shape, the three ends uniting at a center at each extreme. This frame is 48 feet long, and is very securely braced and lashed. It has been thoroughly tested and will support 1,400 pounds with safety.

The engine which drives the propeller is one of the ordinary gasoline type, furnishes 7 horse-power, and weighs 60 pounds. The transmitting mechanism is so adjusted and geared as to cause the propeller to make 150 revolutions per minute. Just what speed can be obtained under ordinary conditions, has not yet been definitely determined by the inventor.

The frame, or car, is placed directly below the balloon—about 12 feet—and weighs 65 pounds. The total weight of the airship is 220 pounds, while its buoyancy will lift nearly 500 pounds. The rudder, which is rectangular in shape, 5 x 3½ feet, is very easily manipulated from any part of the car; and the engine is regulated by a steel lever. One person can very easily navigate this airship. The aeronaut can sit about midway of the frame, or he may move about freely if necessary without disturbing the general equilibrium to any extent.

A weight, which can be shifted from bow to stern, or *vice-versa*, permits the airship to be raised or lowered at will, a feature borrowed from Zeppelin's craft. Capt. Baldwin intends soon to construct another frame that will be 6 feet longer and 15 pounds lighter. He thinks it will increase the speed and facilitate the steering.

So confident is the inventor and builder of success that he has already entered his airship in the $1,000,000 prize competition at the World's Fair. Capt. Baldwin expects to start soon for St. Louis with his aerial machine.

In working the ship, the propeller may be reversed at pleasure, thus pushing the vessel backward, whenever the same is necessary or desirable. The trials showed that the ship very readily obeyed her helm.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

THIRD-RAIL SYSTEM.—T. Jenkins, New York, N. Y. In this case the invention relates to the third-rail system for the propelling of cars, its principal objects being to furnish an effective protecting-cover for the rail and a convenient support for the contact-shoe which will permit the shoe to be moved into and out of the cover and coaction with the rail.

ELECTRIC TROLLEY.—G. Ondo, Delancey, Pa. The invention has reference more especially to what are technically known as "trolley-finders," and one of the principal objects thereof is to overcome numerous disadvantages and objections common to many other structures hitherto devised for a similar purpose. The means employed guide the device to assume the proper relation with the conductor and retained in such relation and the same separated entirely from the conductor when desired.

Machines and Mechanical Devices.

FRICTION-CLUTCH.—C. Seymour, Defiance, Ohio. The object of the invention is to provide a new and improved clutch arranged to hold a movable part under ordinary conditions in position, to allow a limited yielding movement of the said part when under an ordinary strain, and to permit the parts to move any desired distance when under an excessive strain. It is a division of the application for Letters Patent of the United States for a band-saw, formerly filed by Mr. Seymour.

Prime Movers and Their Accessories

WINDMILL.—J. J. McLean, Moose Jaw, Canada. In this patent the invention has for its object to render the construction of windmills more simple, durable, economic, and effective than ordinarily and to provide a means whereby when the windmill is not in use the wind-wheel will be housed and perfectly protected and whereby more or less wind may be directed to the wheel as occasion may require. Means are provided, acting always to keep the blades perfectly facing the wind, which blades are a fixture in the construction of the wind-wheel.

FUSIBLE-PLUG VALVE.—J. L. Downs, North Bergen, N. J. Mr. Downs' purpose is to provide a means whereby in the event the water in a boiler should become so low that the heat from the fire-box melts the fusible plug in the crown-sheet a valve may be quickly brought into action to close the receiver for the plug, and thus prevent steam from entering the box and extinguishing the fire, and also enabling the fire under such conditions to be properly attended to or drawn or banked without undue peril to the stoker or fireman.

Railways and Their Accessories.

HAND-STRAP FOR CARS.—J. S. Paxton, New York, N. Y. The purpose of the invention is to provide a strap for cars having a panel in which an advertisement may be inserted and removed at will, which advertisement may be made to appear upon one or both sides of the panel. Another is to provide a frame for the panel, into which the panel may be readily introduced or from which it may be quickly removed, and also to provide a strap in two sections, upper and lower, the upper having a swivel connection with the frame of the panel and the lower a flexible connection with the frame.

Designs.

DESIGNS FOR A STOVE.—J. P. Ouerbacker, Louisville, Ky. The design in this patent is a stove ornamented throughout its side by an attractive scroll work which gives a pleasing ornamental effect and provides a graceful and artistic panel in the middle of the oven door which may be utilized for any desired purpose.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**
MUNN & CO.

Inquiry No. 5897.—For manufacturers of parts for gasoline engines.

Inquiry No. 5898.—For the manufacturers and the British agent for the "Bliss" log.

Inquiry No. 5899.—For puzzles for advertising purposes.

Inquiry No. 5900.—For makers of steam or hot water heating apparatus for greenhouses.

Inquiry No. 5901.—For machines for weaving straw hats.

Inquiry No. 5902.—For a captive balloon to raise 8 persons 300 feet high.

Inquiry No. 5903.—For manufacturers of spring motors.

Inquiry No. 5904.—For makers of gas stoves and gas heaters.

Inquiry No. 5905.—For parties to turn out a new form of gasoline mantle burner in large quantities.

Inquiry No. 5906.—For machines for planting young onions.

Inquiry No. 5907.—For makers of tool handles and small articles of walnut.

Inquiry No. 5908.—For makers of lathes between jewelers' and foot lathes.

Inquiry No. 5909.—For makers of high-speed steam engine castings to generate 12 to 16 candle power.

Inquiry No. 5910.—For makers of laundry machinery.

Inquiry No. 5911.—For makers of gage rods, hydrometer jars, etc.

Inquiry No. 5912.—For makers of carpet-cleaning machinery.

Inquiry No. 5913.—For machines for making old carpets into rugs.

Inquiry No. 5914.—For machinery for making apple jelly, etc.

Inquiry No. 5915.—For makers of power lace machines.

Inquiry No. 5916.—For makers of machine for making copra, or for taking meat from the cocoanut.

Inquiry No. 5917.—For manufacturers of wood-carving machinery.

Inquiry No. 5918.—For makers of flywheels for engines of 20 to 30 h. p.

Inquiry No. 5919.—For makers of pins, hair pins, combs, hooks-and-eyes, etc.

Inquiry No. 5920.—For makers of furnaces for smelting lead, tin and Babbitt dross.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(9445) R. G. P. asks: Could two sets of storage batteries be put into a vehicle so that one set will be running the vehicle and the other will be charged by the same vehicle; and how fast has a dynamo got to run to make electricity? A. If a storage battery is doing the work of running a vehicle it will not have any power left with which to charge another battery strong enough to run the same vehicle. It would not be economical to use a storage battery for the purpose of charging another storage battery. There is always a percentage of loss in transforming electricity from one form to another. A dynamo may be built to run at various speeds up to several thousand turns per minute.

(9446) LeG. L. W. asks: I am in want of information how to make small spark or induction coils, etc. Where may I find same? A. You will find in our Supplement No. 160, which we send for ten cents, full instructions with all needed illustrations and drawings for making an induction coil which may give a spark from 1 inch to 1½ inches in length. Supplement No. 1124, price ten cents, treats in a similar way a coil giving a spark 6 inches long. In Norrie's "Induction Coils," price $1, you will find details of coils giving sparks from ½ inch to 12 inches in length. Among these you can surely find what you want. We shall be pleased to receive your order for the books you wish.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending August 16, 1904

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Adding machine, W. H. Pike, Jr. 767,596
Adding machine, R. Corbin 767,871
Air and bisulfid of carbon contained in viscose, apparatus for extracting, L. Naudin 767,421
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